

# consulting engineer



*From Caracas to Chicago*

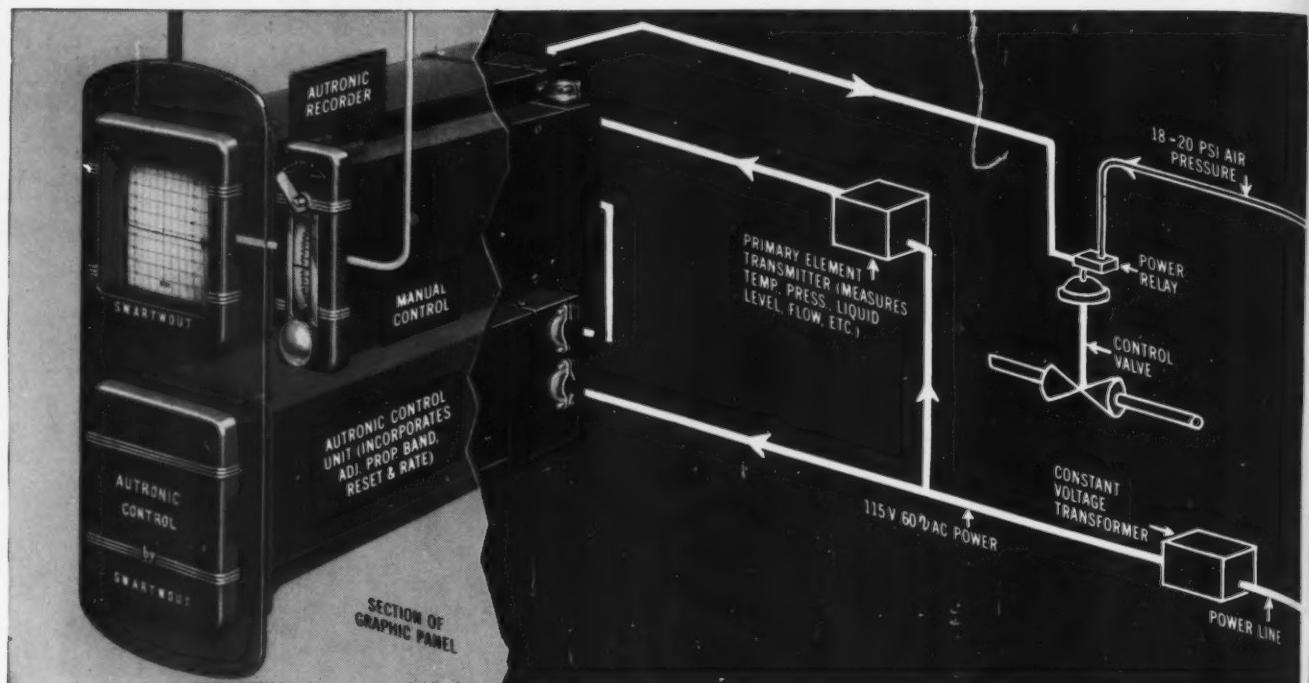
## Subways to Smokestacks

CHARLES EDMUND De LEUW entered the University of Illinois in 1908 with the avowed intention of becoming a bridge engineer. The firm which is now the manifestation of his career can say that it has built some of those bridges its founder had in mind 45 years ago; but along with <sup>1853</sup> the consulting practice of De Leuw, Cather and Company has

*(Continued on page 8)*

LOWAN, WILSON

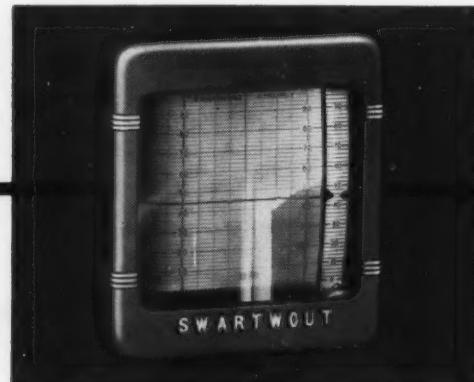
# Miniature all-electronic system for instantaneous measurement and control of process variables...



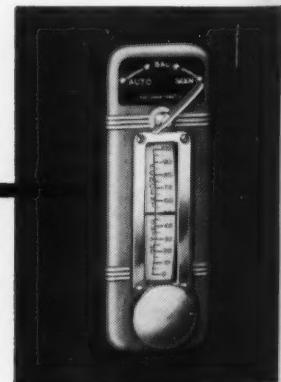
**1** Regardless how fast a pneumatic or electro-mechanical system may function, it cannot compare with the *instantaneous, all-electronic* response of the Swartwout Autronic Control System. Here's why. Since transmission of information throughout the system is by *electrical means only*, there is no mechanical motion . . . no slide wires, boosters or motors to initiate control action . . . no control air lines from primary element or to final element. Hence the Autronic Control System spans distance between primary and final elements without internal —for closer, more accurate control.



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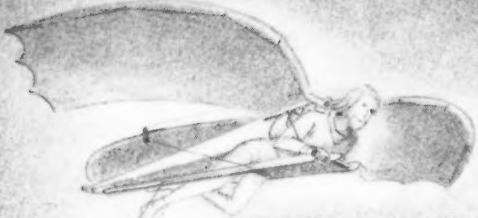
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Write for details.

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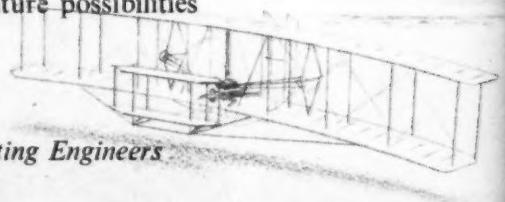
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It takes more than imagination and a burning ambition to fly. It also takes more than "inventiveness" to make flying practical and profitable. Flying today is big business—helped made big by men of vision.

The Consulting Engineer helps keep this industry from falling into the perils of Obsolescence. Call on him to help you keep your eye on future possibilities as well as present profits.

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*Thermix, Project Engineers to Consulting Engineers*



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PROJECT ENGINEERS

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*One of a series of advertisements to Industry*



XUM

VOLUME 2  
NUMBER 3

# consulting engineer

MAY 1953

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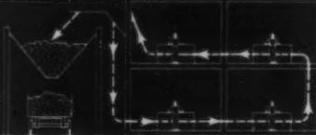
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upstairs...  
downstairs...



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DIVISION HAPMAN-DUTTON COMPANY  
KALAMAZOO MICHIGAN

*Very Truly Yours*

ONE PART OF MY JOB which is particularly interesting is the editorial meeting. You can take my word for it—no one could be more critical of CONSULTING ENGINEER than our own editors. However, the really interesting part of our meetings has to do with planning ahead. In the last meeting I made notes about some of the articles and reports that are in the "hopper".

How to give you some really useable information on atomic energy merits our best efforts. The government has now released enough data, prepared by private companies who have been investigating the practicality of private financing of atomic fuel power generating plants, to indicate that a really good story can be had if this data were consolidated and carefully interpreted. Straight government releases will not be run—you'll find that in almost every magazine. We'll give you, probably in July, the basic economic and technical data to cover fully all developments to date.

Another interesting story is developing on free piston gas turbine units. The behind the scene story here comes from Europe. The French and Swiss have been developing this engine, which works on the diesel cycle but has no crank-shaft or flywheel, far longer than we have in this country. There has been a sudden rash of stories in the trade press, but no one seems to know what really is going on. We do, and we are going to tell our readers. Watch for this. I know you're going to like it.

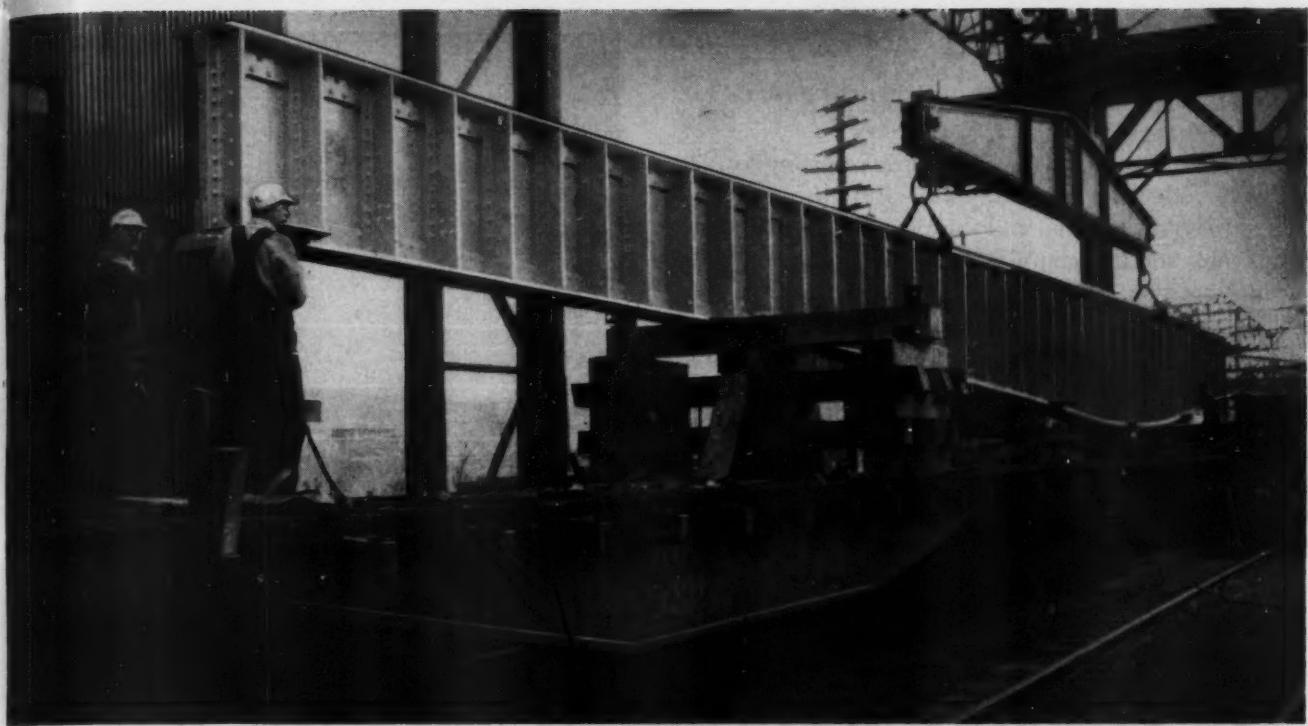
On the management side of the ledger, there's an outstanding article from Carl Heyel, an Associate Partner of the management consultant firm of George H. Elliott & Co. This is the story of how history's biggest management survey (the City of New York) was organized and carried through. Scheduled for June, and it's informative in an especially interesting way.

You can get in on these planning meetings, too. Just let us know if you have a subject you'd like to see treated in a special article. Our editors will sincerely appreciate your suggestions.

Very truly yours,

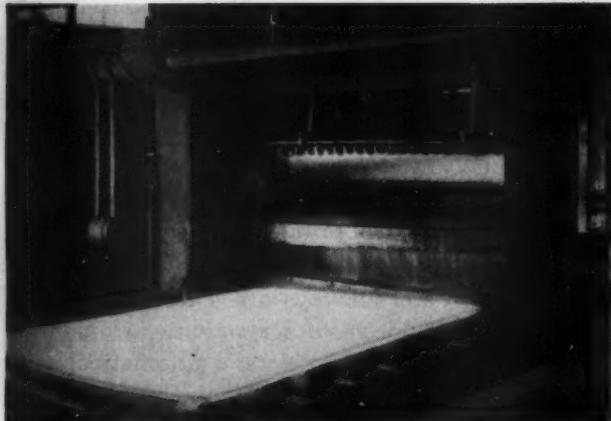
*M.J. Sanders*  
General Manager

CONSULTING ENGINEER



A GIANT STRUCTURAL GIRDER being readied for shipment at Phoenix Bridge Company, Phoenixville, Pa., fabricators of structural and plate steels.

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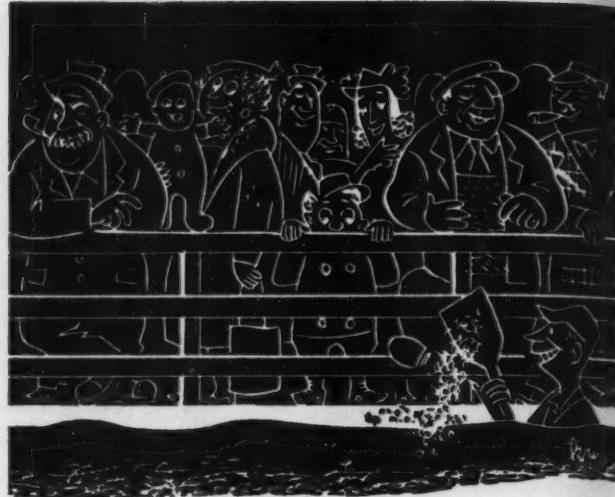
## Subways To Smokestacks

—(Starts on Front Cover)

included railroads, industrial works, power plants, subways, electric systems, tunnels, highways, traffic surveys, airports, and municipal construction. The value of the completed projects the firm has been associated with is well over \$300 million.

The beginnings of this career are seated in Jacksonville, Illinois, where De Leuw was born in 1891; he was raised in Jacksonville where he worked for about a year in a steel fabricating plant. This is where he really made up his mind that he should be a bridge engineer. The decision in Jacksonville carried him ultimately to Bangkok, to Caracas, to Manila, to San Francisco, to Montreal.

He did his stint with the Army in World War I. Even here, the pattern of De Leuw's career conformed and contributed to the course on which he was being propelled. First it was Lieutenant and then Captain De Leuw of the Fourth United States Army Engineers. After his discharge, he teamed up with R. F. Kelker Jr. to form Kelker, De Leuw and Company in 1919. Kelker was a public transportation man; his background combined with De Leuw's civil engineering shaped the future characteristics



of the De Leuw career from that time on.

Fifteen days before black Monday heralding the Great Depression in 1929, the firm which is now De Leuw Cather and Company was formed. The new firm barely weathered the lean days; in one year the rent exceeded the gross income. Conditions did improve with the stimulus of the founding of the Public Works Administration in 1933. In this year, De Leuw was made assistant chief highway engineer of Illinois and thus established himself again in the transportation field. Three years later he was named consulting engineer for Chicago's Department of Subways and Super-Highways. He saw the Chicago subways through from conception to completion. Now, his subway interests lie in Toronto's underground slated for completion this year—and in Montreal's project, now in preliminary planning stages.

De Leuw and subways are a famous combination. But to exclude his other activities would be to exclude International Harvester's automatic foundry in Louisville; Barranquilla, Columbia's water works; Sidney, Nebraska's Sioux Ordnance Depot; Oklahoma's Turner Turnpike; El Paso's Bataan Memorial Trainway; and New Jersey's Turnpike.

Currently, De Leuw and his organization are concerned with Toronto's new subway with its new track construction and noise reduction innovations. He is consultant to the Air Force's Committee on Installations and, among other projects, is working on industrial electrical facilities for Kaiser Aluminum.

The Western Society of Engineers always has been one of De Leuw's favorites; he will be President of the group next season. There are some eleven other professional societies in which he holds memberships although probably the most significant currently is the American Institute of Consulting Engineers; not at all out of character, De Leuw is vice-president of the AICE.

### ONE CONTROL DOES THE JOB OF TWO



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CLEAN STACKS is only one of the advantages Stowe Stokers can give you. Extremely high rates of burning per square foot of grate area; rapid response to fluctuating loads; the ability to burn any grade of coal; are some of the others. Why not get full details? Write for Bul. No. 501. It tells what Stowe Stokers do — and why they are able to do it.



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Manufactured by THE JOHNSTON & JENNINGS CO. • 6917 Bessemer Avenue • Cleveland 27, Ohio  
... Division of PITTIBONE MULLIKEN CORP...



### Stick to Engineering?

Sir:

A copy of the April issue of CONSULTING ENGINEER was handed to my husband to peruse, and he was intrigued with the article by Frederick H. McDonald, "Engineers Should Stick to Engineering." Since he has been promoted to Consulting Engineer with his firm, this article appealed to him very strongly after having served in a managerial capacity.

... The article clicks with his ideas, and he hopes you will carry more on the subject. In the meantime, send one copy of the April issue to my husband for reference.

Mrs. W. J. Ettinger  
Lombard, Illinois

Sir:

... I refer to the article in the April issue by Mr. Frederick H. McDonald, "Engineers Should Stick to Engineering."

I have been in private practice, starting two years after my graduation from the University. I soon learned that my technical education was inadequate to prepare me for such a career, and I went back to night school and took a course in contract law and a course in economics. I also engaged in various activities of a civic nature.

From those early days in my career I was possessed with the idea that if engineers wanted to really amount to something in addition to being skilled mechanics they must broaden their education into general fields and must carry their share of responsibilities as citizens of the Republic.

In the early forties I was chairman of the Committee on Education of the National Society of Professional Engineers, and our Committee recommended to the Society that degrees in engineering should not be given unless the student had completed a five year course in engineering,

which course included at least 20 per cent of the time devoted to study of humanities. The Society submitted this recommendation to the various engineering colleges of the country. The reaction varied all the way from a flat "no" to "yes". My own University of Minnesota was one that said yes, and it is my understanding that the results have been very satisfactory.

Based upon my own experience and observation, I would say that the unfortunate experience of the Mr. John Currie mentioned in the article was due to lack of understanding of the fundamental principles of diplomacy or his failure to apply those principles if he understood them. That, in turn, goes back to lack of education in the broader sense, which is not acquired by exclusive devotion to engineering subjects or practice.

Walter H. Wheeler  
Professional Engineer  
Minneapolis, Minn.

### Satisfied Readers

Sir:

We appreciate being on the mailing list of the CONSULTING ENGINEER. The magazine should be a valuable addition to our library and we hope that succeeding issues will have articles maintaining the standards set by the first. We of the library naturally like book review section best, but we are sure that each of the feature articles will find appreciative readers among the faculty and students using this library.

Robert Scott,  
Columbia University  
New York, New York

Sir:

We would like very much to compliment you on your new periodical. We feel that this includes a number of excellent articles and we are accordingly taking pleasure in routing it to a number of the Realty Corpo-

ration Engineering Staff who are interested in various fields covered in this issue.

J. C. Nowell, Manager  
Engineering & Construction Dept.  
General Electric Realty Corporation  
Schenectady, New York

### Reader Requests

Sir:

One of our members, C. Carter Brown, of the firm of Brown and Butler, has directed to our attention an article concerning parking problems which appeared in the March issue of CONSULTING ENGINEER. This organization is vitally interested in obtaining all the authentic information it can concerning this vital topic . . .

Opie L. Shelton  
Chamber of Commerce  
Baton Rouge, La.

Sir:

Your April 1953 issue has come to my attention. I am particularly interested in the article "What are Parity Prices of Fuels", by W. S. Major. If possible, I would very much appreciate receiving a reprint of this article.

D. W. Beery  
Blaw-Knox Company  
Chemical Plants Division  
Pittsburgh, Pa.

• WE CAN FURNISH OUR READERS A FEW EXTRA TEAR SHEETS OR REPRINTS OF MOST ARTICLES ON REQUEST. COMPLETE ISSUES ARE AVAILABLE AT 50 CENTS THE COPY.—ED.

### Liked Elevator History

Sir:

... I was particularly glad to have the opportunity of reading the article on the history of vertical transportation. I have been trying now for some years to run down historic dates in the field of materials handling and this one added considerably to my knowledge.

Thought you might be interested in some of my projections for the future . . . so I am enclosing three talks given at various times . . . Buck Rogers paragraphs are noted in red pencil.

Mr. Gusrae's article will certainly find a place in my permanent file of materials handling lore.

R. C. Sollenberger  
Executive Vice President  
Conveyor Equip. Mfrs. Assn.  
Washington, D.C.

### Reactions

Sir:

My reaction is that this magazine is more a research of manufacturers

# INSULATED METAL WALLS

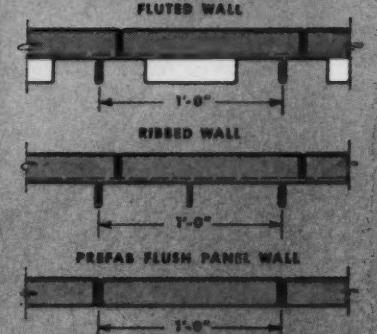
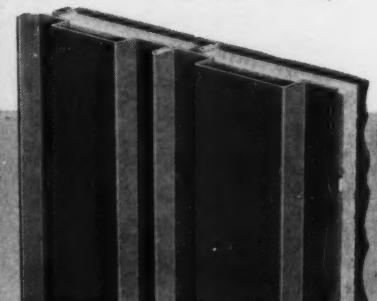
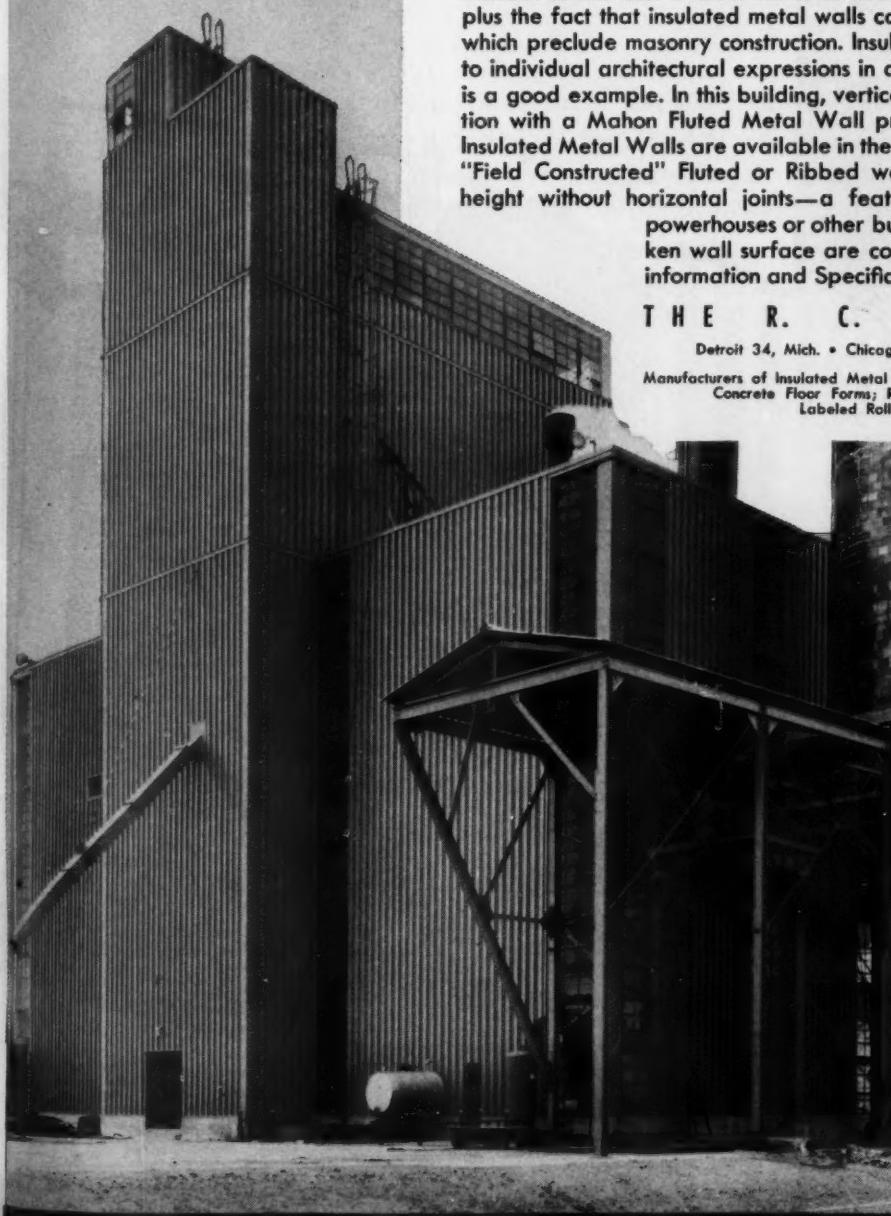
for INDUSTRIAL and COMMERCIAL BUILDINGS  
ALUMINUM, STAINLESS or GALVANIZED STEEL

More and more architects are turning to insulated metal walls for industrial plants, powerhouses and other types of industrial and commercial buildings where this modern wall construction offers certain definite advantages. These advantages include: Lower cost in both material and labor, reduction in construction time—plus the fact that insulated metal walls can be erected under weather conditions which preclude masonry construction. Insulated Metal Walls also lend themselves to individual architectural expressions in design—the powerhouse illustrated here is a good example. In this building, vertical panels of continuous sash in combination with a Mahon Fluted Metal Wall produces a striking appearance. Mahon Insulated Metal Walls are available in the three patterns shown below. The Mahon "Field Constructed" Fluted or Ribbed wall can be erected up to sixty feet in height without horizontal joints—a feature which is particularly desirable in powerhouses or other buildings where high expanses of unbroken wall surface are common. See Sweet's Files for complete information and Specifications, or write for Catalog No. B-53-B.

THE R. C. MAHON COMPANY

Detroit 34, Mich. • Chicago 4, Ill. • Representatives in All Principal Cities

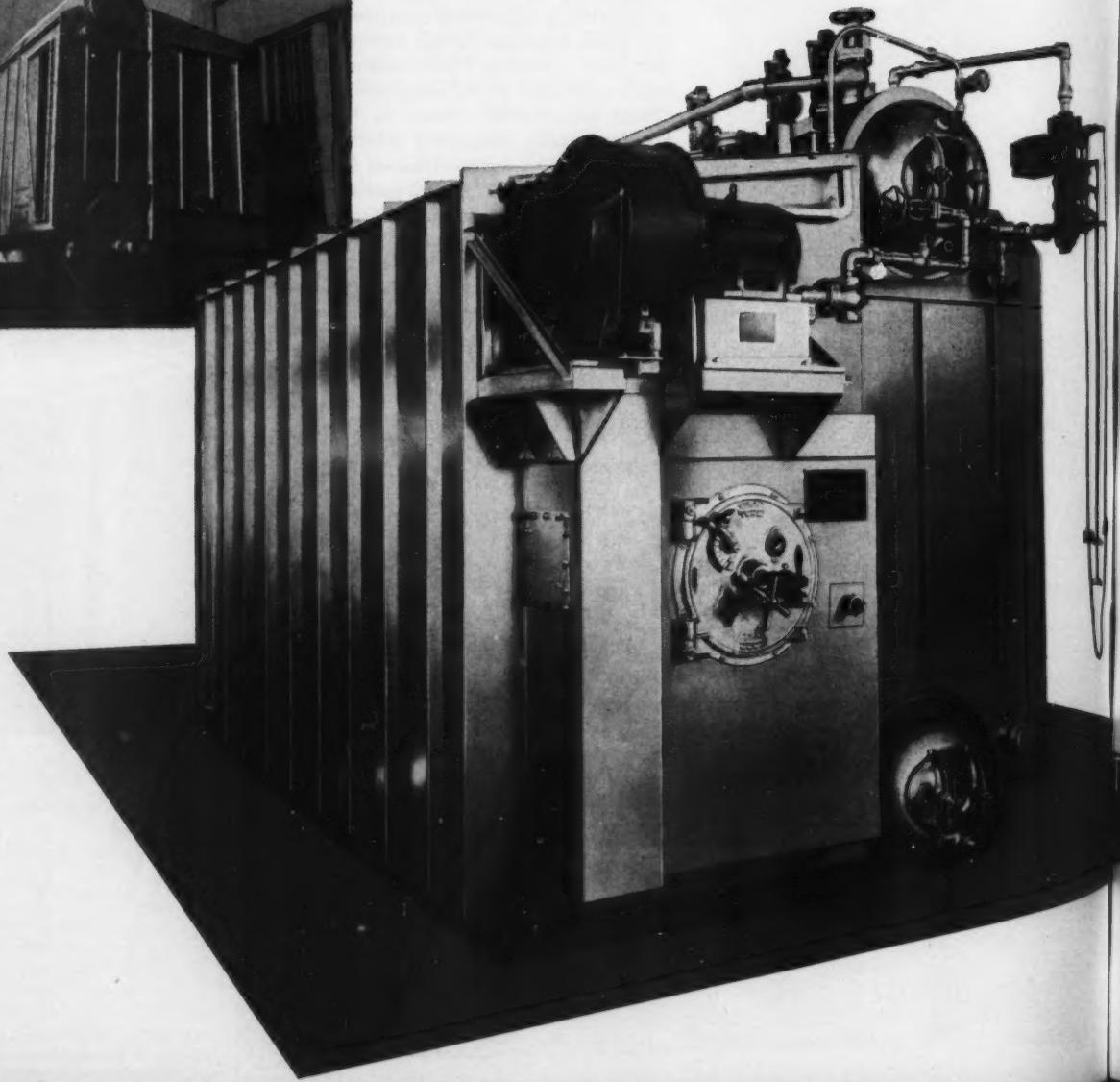
Manufacturers of Insulated Metal Walls; Steel Deck for Roofs, Partitions and Permanent Concrete Floor Forms; Rolling Steel Doors, Grilles and Underwriters' Labeled Rolling Steel Doors and Fire Shutters.



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COMBUSTION ENGINEERING BUILDING  
200 MADISON AVE., NEW YORK 16, N.Y.

# e VP Boiler...

## THE PACKAGE BOILER WITH extra FEATURES

Most of the water-tube "package" boilers available today look very much alike. As a matter of fact, in some respects they are alike.

The prospective purchaser's job is to discover which of the several package boilers now available offers a combination of features and advantages that adds up to the "best buy".

Consider, then, the fact that the C-E Package Boiler, Type VP, has *all* the design features offered by any of its contemporaries *plus* the following extras—

**Fully Water-Cooled Furnace** — Even the front or "burner" wall is protected, except in three smallest sizes. Has higher ratio of furnace-wall cooling to furnace volume than any boiler of its size and type. Assures rapid and efficient heat absorption, lower gas temperatures entering convection bank, reduced tendency to slag formation. Minimizes furnace maintenance.

**Larger Lower Drum** — The large lower drum, 30" in diameter, permits simple, symmetrical tube arrangement; provides easy access when necessary for washing down or for inspection; greater water storage capacity facilitates handling fluctuating loads.

**Centrifugal Fan** — This type of fan is more efficient, operates at lower speed and is quiet in operation. The average noise level is less than half that of typical high-speed blowers used on most boilers of this type. Low noise level is particularly advantageous in confined space and in such installations as hospitals.

**Simple Baffle Arrangement** — Minimum changes in direction (no baffle at all in convection bank in larger size units). Gives lower draft loss. Simplifies soot blowing. Cross-flow of gas with elimination of dead pockets gives maximum heat pick-up. Water-cooled baffle in intermediate sizes ensures minimum maintenance.

**VP Boilers are available in capacities from 4,000 to 30,000 lb of steam per hr; pressures to 250 psi. Send for Bulletin VP-10.**

BOILERS, FUEL BURNING AND RELATED EQUIPMENT FOR POWER, PROCESS AND HEATING REQUIREMENTS; PACKAGE STEAM GENERATORS; SUPERHEATERS AND OTHER AUXILIARIES FOR STEAM LOCOMOTIVES; PULVERIZERS, AIR SEPARATORS AND FLASH DRYING SYSTEMS; PRESSURE VESSELS; AUTOMATIC GAS AND ELECTRIC WATER HEATERS; SOIL PIPE AND FITTINGS.



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B-3-5

than should be expected in a consulting engineers' magazine, particularly in the fact that the word consulting engineer covers a tremendous range of activities and many consulting engineers would not be interested in this type of publication.

Edward E. Ashley  
Consulting Engineer  
New York, New York

Sir:

Consulting engineers need a publication of their own since consultants are faced with many problems which directly affect their pocket-books. I have reference to the enormous amount of free work that is being done by universities and the industries. Time does not permit me to go into this matter in detail. . . .

H. A. Wagner, Director  
American Association of Engineers  
Chicago, Illinois

Sir:

I enjoyed the article by Mr. Kiljan and Mr. Levonian regarding the major steps taken in planning turn-key projects. The one important phase omitted was a discussion of the various types of fee arrangements made for this type of work by engineering construction firms.

Please see if you can get someone with wide experience in this field to discuss this freely and in detail.

Tom C. David  
Pan American Engineers  
Alexandria, Louisiana

\* FEE ARTICLE IS SCHEDULED FOR JUNE ISSUE.—ED.

**Dues Deductible?**

Sir:

Noted your item in "Scraps & Shavings" in April referring to the many unusual associations in this country. Be on the lookout for a member in good standing of the World Association of Detectives who is (with membership card in hand) tracking you down under the auspices of the American Snow Shoe Union to call to your attention that you omitted from your list the National Institute for Commercial Trade Association Executives.

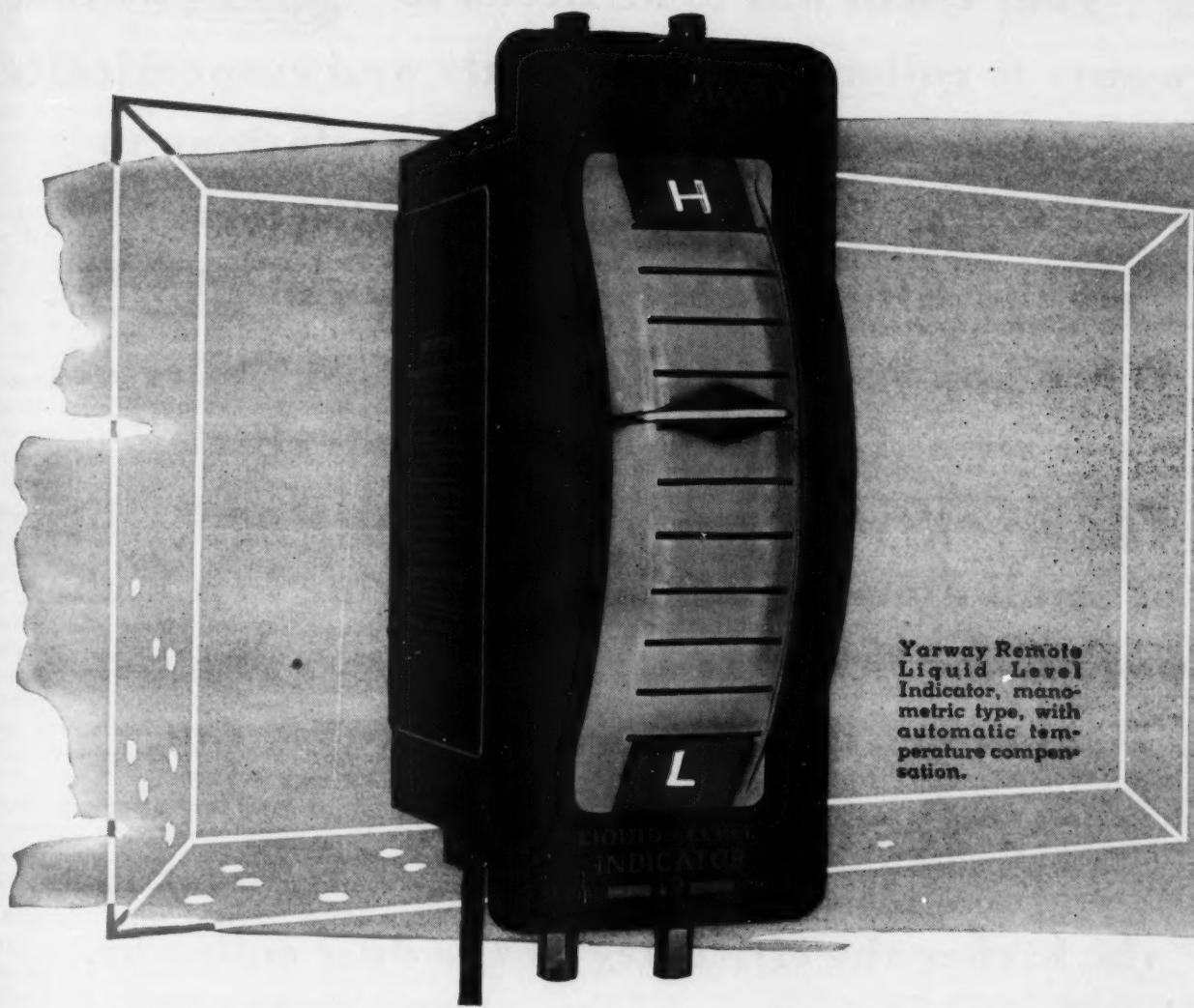
No doubt it is this group, and its parent organization, American Trade Association Executives, which is responsible for the healthy state of organizations in this country. They are, no doubt, guiding us to new heights as joiners. (Soaring Society of America take note.)

Lanier M. Allison  
Gold-Tex Fabrics Corp.  
Rock Hill, S. C.

CONSULTING ENGINEER

# *What's New*

## **IN BOILER WATER LEVEL INDICATION?**



Yarway Remote  
Liquid Level  
Indicator, mano-  
metric type, with  
automatic tem-  
perature compen-  
sation.

### **IMPROVED WIDE VISION REMOTE LIQUID LEVEL INDICATOR**

A new-type face on the Yarway Remote Liquid Level Indicator now permits side as well as head-on dial readings. This vastly improved visibility makes it possible to check boiler water levels from most any position in the control room, or wherever the Yarway Remote Indicator may be installed.

#### **MANOMETRIC TYPE**

The Yarway Indicator is a manometric type with automatic temperature compensation. Level readings are instant and accurate because the indicator is operated by the boiler water itself. The indicating

mechanism is never under pressure. There are no stuffing boxes.

Over 8,000 Yarway Remote Liquid Level Indicators are successfully operating throughout industry—primarily for indicating boiler water levels, but also for many other liquid level applications, and for superheater pressure differential indication aboard ship.

For full information on Yarway Indicators, write for Yarway Bulletin WG-1823.

**YARNALL-WARING COMPANY • 106 Mermaid Avenue, Philadelphia 18, Penna.**

# **YARWAY**

## **STEAM PLANT EQUIPMENT**

**A**s a Consulting Engineer whether your client has to or needs to wants to collect dust efficiently and economically because it's good public relations to do so, Prat-Daniel Dust Collectors are the difference between black and white.

When you specify **Pd** Mechanical Collectors your client is assured high over-all efficiency.

**Pd** Collectors are designed with a multiplicity of small diameter tubes resulting in a higher sustained efficiency over a wide operating range.

The smaller the diameter of the tube the greater the centrifugal force on the dust particles. The greater the centrifugal force the higher the efficiency of the dust collector.

That's why when quality and results are the determining factors it pays to specify **Pd** Collectors. Why not contact The Thermix Corporation, Project Engineers for Prat-Daniel, specialists in this field?

Project Engineers **THE THERMIX CORPORATION** GREENWICH, CONN.

(Offices in 38 Principal Cities)

Canadian Affiliates: T. C. CHOWN, LTD., Montreal 25, Quebec; Toronto 5, Ontario

Designers and Manufacturers

**PRAT - DANIEL CORPORATION** SOUTH NORWALK, CONN.

These are Prat-Daniel Products

POWER DIVISION: Tubular Dust Collectors, Forced Draft Fans, Air Preheaters, Induced Draft Fans, Fan Stacks.

THERMOBLOC DIVISION: Direct-Fired Unit Heaters for Industrial and Commercial Applications.

## Economic News Notes —

*E. J. MacDonald*  
INDUSTRIAL ECONOMIST

NEW HORIZONS. Plans are being formulated for "splitting" the atom between the Government and private industry. Although it will take some months before Congress can rewrite the law to permit private concerns the use of uranium for generating commercial power, recommendations have already been drawn to license private companies to hold "critical" quantities of uranium, to produce and sell to the Government plutonium and other fissionable materials, and to provide patent-rights protection for companies engaged in research and experimental work on developing electric power from the atom. This is the start towards billions in new construction.

NEW ATOMIC ENERGY STUDY GROUP. Executives of 13 corporations and educational institutions have joined in organizing in New York, the Atomic Industrial Forum, Inc. The association, formed as a consequence of a proposal by Dr. Keith Glennon, president of Case Institute of Technology, shortly after he had resigned as a member of AEC, will foster and encourage, as well as attempt to solve the problems of the civilian application of atomic energy.

NEW POWER POLICY. The House Appropriations Committee backed up its recent recommendation to the Interior Department that it quit competing with private enterprise in the field of power generation by cutting the department's appropriation for fiscal 1954 by one-third of the amount Mr. Truman budgeted last January. Sharp reductions were made in funds requested for transmission lines and power plants. The Committee stated that Interior should be "concerned only with those functions or activities which private enterprise cannot or will not undertake. Where private enterprise is unable to develop resources without assistance, there should be a working partnership between the Federal Government and private interests . . ."

A SHARP KNIFE. So far, the Budget Bureau and the House Appropriations Committee have cut deeper into the Truman budget than had been expected. Up to the end of April, reductions recommended were right down the line—Commerce, Agriculture, Labor, Treasury—with construction projects hit hard in reduced appropriations for Interior and the Corps of Engineers. At that time the biggest new money items were yet to be considered: defense program, foreign aid, and atomic energy. The Senate has almost traditionally raised House-approved amounts, but this year they will be under the pressure of President Eisenhower's request that Congress appropriate "at least \$8.5 billion less" than Mr. Truman had recommended for fiscal 1954.

CHERCHEZ LA FEMME. According to a recent survey of 176 companies, only 68% of their needs for engineering graduates were satisfied in 1952. It is estimated that for 40,000 available engineering jobs this year, about 23,000 students will graduate with engineering degrees, a substantial number of whom will enter military service. In 1954 only 19,000 graduating engineers are expected; in 1955, 22,000; and in 1956, 29,000. By 1960 the annual increment will have reached 40,000, still, however, running well behind needs. This would suggest that Personnel Administration consider greater training of women for engineering adjunct positions and that women be fully informed of the growing opportunities of an engineering career.

\$3000 PER STUDENT. A new system through which industry may find it possible to compensate privately endowed colleges and universities for "value received" in the training of engineering and other graduates has been worked out by Bethlehem Steel. The company will offer financial aid to approximately 45 institutions in proportion to the number of their students selected by Bethlehem for its annual training program. The amount of payment for each grad's training has been set at \$3,000. Bethlehem Steel has normally taken on more than 100 men each year in its college graduate training program, known as the Bethlehem Loop Course. However, this idea of Bethlehem's has not been too well received by other companies competing for graduates.

KEY TO PROSPECTIVE BUSINESS. Output of passenger cars for the third quarter is scheduled at 1.9 million. If this number actually rolls off the production lines, it will be an all-time record. Supporting auto makers' optimistic goals is the strong rise in demand, reflected in sales of around 500,000 new cars in March, 48% greater than the same month last year. Another basic factor is the continued rise in personal income which in February, latest month reported, was at an annual rate of \$280.4 billion, 6% higher than a year ago.

PRINCE OR PAUPER. Shipbuilding hit its lowest point in the past 21 months in U. S. yards in March. Only 82 vessels were on building ways or on order, and no new contracts were reported received during the month.

SMALL BUSINESS—SMALL SHARE. A special report by the Senate Small Business Committee discloses that, after the defense contracting dollar has been fully spread around to manufacturers, only about 14% of it goes to small concerns. Previous studies maintained that small businesses get a larger share of the subcontract dollars as the process continues and subcontracts are let out to other manufacturers. The recent report, however, contends that "The fact is that, although small business gets a larger share of the subcontract dollars at lower levels, the portion of the dollar going out to subcontractors diminishes steadily as the subcontracting structure deepens."

SMALL BUSINESS—BIG TAX. The excess profits tax takes its heaviest toll from small business, according to a survey by the National Association of Manufacturers. Of 2,639 companies reporting as having been subject to the tax, 78.6% were in the category of small businesses employing 500 or less persons. NAM stated that detailed replies of some 1,500 companies revealed a pattern of plans for expansion scrapped because of lack of funds, as a result of the tax. Undersecretary of the Treasury Folsom recently stated that "Any long continuation of this form of taxation could not be justified because it is incompatible with healthy economic growth."

FEDERAL PURCHASING AGENT. The General Services Administration is expanding its role as buyer of the Government's "housekeeping" items. It is assuming the job of buying such items—from aspirin to zincographs—for the military services. This will result in a four-fold increase in the volume of stores items bought almost entirely from private companies by GSA.

## Scraps & Shavings . . .

THE AVERAGE MAN, we had hoped, had been plowed under with Henry Wallace's hybrid corn or little pigs or whatever else it was they plowed under in the thirties. However, we can add to the statistics on this weird creature by factually stating that he (or it) is a remarkably strong and healthy organism. He has become a solid part of "the American Way", and a right-hand man for every advertising and publicity organization. It seems that every third release we have received deals with man as some sort of an average. Just for example, a publication called *Automobile Facts* (which for some reason gets to our desk each month) carries a picture of a plastic dummy which is labeled as "Mr. Average Man." It is 5 ft 9½ in. tall and weighs 166 pounds. It is being used to plan motor vehicle interiors so they will provide "maximum comfort, convenience, and visibility for the driver." This means, we suppose, that our new cars will be comfortable, convenient, and have ideal visibility for all men (and presumably women) who are 5 ft 9½ in. tall and weigh 166 pounds.

The lead story in B. F. Goodrich Circle-News

(April 17) also deals with average men and women. It seems that some busy boy figured out all about the average "Mr. Factory Employee", "Miss Factory Employee", "Mr. Salaried Employee", and "Mrs. Salaried Employee." "Mr. Factory Employee", for example is 45.42 years old and has been with the company "approximately 16.85 years", which goes far enough past the decimal point to satisfy us. One thing we do wonder about is why the average female factory employee at Goodrich is "Miss", while her counterpart in the office is "Mrs." But we will not go into that unless the matter is brought up again in a later issue of *Circle-News*.

Mr. Don Scheu was picked by the editor of *Circle-News* as the average salaried employee. He is field engineer on flat belts from Dept. 7194, and he and his wife live at 693 Good Park Blvd., in Akron. We'll hope Mrs. Scheu doesn't think Mr. Scheu is average.

Personally, we think "Mr. Average Man" has just about fulfilled his usefulness in this country, and we are strongly in favor of promoting the age of the individual. This has nothing to do with developing a race of supermen or even "rugged individualists"—who are quite different in yet another way from free men living their own lives and running their own jobs the best they know how. Man should fit no mold—he is the molder.

## NEW TYPE WATER FILTER . . . for industrial plant water, municipal water supply and swimming pools The SPARKLER Model SCJ Diatomite self cleaning filter

—combines the uniform consistant quality of diatomite filtering with a quick cleaning system of jet spray wash off of plates and backwash.

The filtering element is composed of orlon cloth covered screen discs that readily take an even pre-coat of diatomite circulated from a slurry tank.

The filter cake can be quickly and completely washed off with a built-in jet spray and the filter cleaned by backwash with a minimum of backwash water and plates recoated ready to resume service within a total cleaning time of 10 to 15 minutes.

For the first time, in this new development, Sparkler Engineers have successfully combined the desirable features of diatomite filtering and fast self cleaning, without bridging or loss of filtering surface and with the use of very little filtered water at a low flow rate. The distinctive advantages of this type of filter are:

- 1 Removal of 80% to 100% of bacteria depending on the type of bacteria and the grade of diatomite used in addition to all suspended matter either colloidal or solid. Thus the required chlorination is reduced materially.
- 2 First cost of a SCJ filter installation is about half that of a sand filter of equal flow capacity.
- 3 Floor space required for a Sparkler Model SCJ filter is much less than usually anticipated when compared with some other types of filters. The large size SCJ filter with a capacity of 96,000 G.P.H. requires a floor space of only 97" x 77" with overall height of 84".
- 4 Operation is simple and can easily be handled by any plant mechanic. Standard single SCJ filter units available in capacities up to 96,000 G.P.H. Multiple units can be used for larger requirements. Also, larger single units can be custom built when desired.

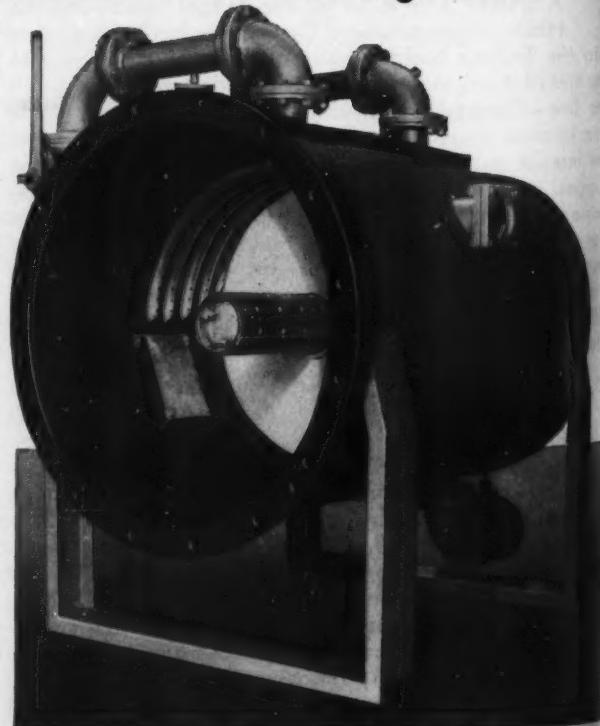
Personal supervision of each installation is made by a Sparkler engineer.

WRITE MR. DAN D. BALDWIN FOR PLANS AND PRICES ON YOUR REQUIREMENTS

**SPARKLER**

MANUFACTURING CO., Mundelein, Ill.

MAKERS OF FINE FILTERING EQUIPMENT  
FOR INDUSTRIAL USE FOR OVER A QUARTER OF A CENTURY.



**INTRODUCING . . .** the new member of the Dravo Space Heater family

## **DRAVO GAS-FIRED Suspended Type UNIT HEATER**

**—for heating and ventilating  
commercial and industrial buildings  
—for process drying**

Now . . . Dravo Corporation offers you the new Dravo Gas-Fired Unit Heater, ideal for installations requiring a heating output of 68,000 to 172,000 Btu. This new addition, joining the Dravo Counterflow Space Heater models, makes available a range of Dravo Heaters from 68,000 to 2,000,000 Btu.

### **ENGINEERED DESIGN**

The Dravo Gas-Fired Unit Heater is ruggedly constructed with a cast iron heat exchanger, cast iron burners and a heavy-gauge steel exterior jacket with baked enamel finish . . . all designed for years of satisfactory service.

### **EASY INSTALLATION**

The Dravo Gas-Fired Unit Heater is delivered completely assembled. Installation requires only hooking up gas connection and exhaust stack. Units are wall-hung or suspended from roof trusses to conserve valuable floor space.

### **DESIGNED FOR SAFETY**

Dravo Gas-Fired Unit Heaters are approved by American Gas Association and listed by Underwriters' Laboratories, Inc. Safety pilot turns off gas automatically if the pilot light goes out or burns too low for perfect ignition. The cast iron heat exchanger and combustion chamber withstand corrosion and will not burn out.

### **EFFICIENT OPERATION**

The Dravo Gas-Fired Unit Heater has a minimum heating efficiency of 80%. The draft hood prevents down drafts, absorbs all excessive chimney action and conserves heat. The heater delivers the exact amount of heat where you want it . . . when you want it. Automatic thermostat controls are available if desired.

### **AVAILABLE NOW**

Units are available in a variety of sizes from 68,000 to 172,000 Btu, equipped with a fan or blower. Blower models are recommended for installations requiring heated air at greater velocity or against greater static pressure.

Dravo Corporation, Heating Department  
Fifth and Liberty Avenues, Pittsburgh 22, Penna.



I want complete information on the new Dravo Gas-Fired Unit Heater.  Please send me Bulletin No. OP543

Please have a representative call.

Name \_\_\_\_\_

Title \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

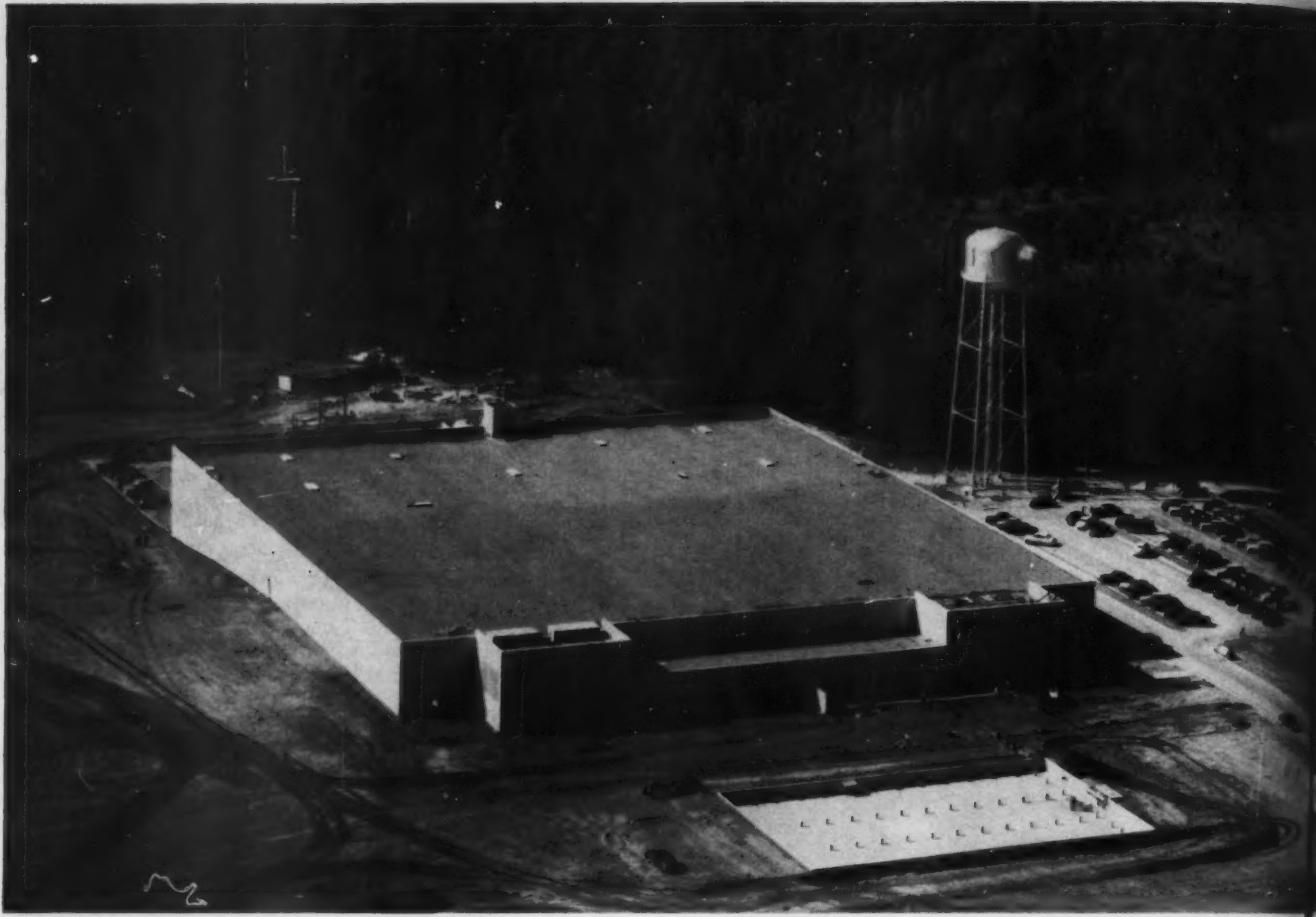
### **WRITE FOR INFORMATION**

Get the complete details now describing the new Dravo Gas-Fired Unit Heater. Use the coupon.

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C. G. ENGLUND



C. A. THRASHER

## Selecting Contractors On a Fixed Fee Basis

By C. G. ENGLUND, Vice-President

Daniel Construction Company, Inc. of Alabama

And C. A. THRASHER, Vice-President

Daniel Construction Company

A graduate of the Worcester Polytechnic Institute, C. G. Englund started his career as field engineer with the U. S. Bureau of Public Roads. Then, after much varied industrial construction experience, he joined the forces of Daniel Construction Company, Inc. of Alabama in 1937, as chief engineer in their Birmingham office. Now Vice-President of this company, he has had direct charge of such major construction projects as Reynolds Metals Company, Sheffield, Alabama (\$20 million); Coosa River Newsprint Company, Childersburg, Alabama (\$30 million); The Chemstrand Corporation, Decatur, Alabama (\$30 million); together with many of the large Government projects during World War II.

C. A. Thrasher, also a Vice-President of the Daniel Construction Company, is located at the company's Greenville, South Carolina office. He is a civil engineering graduate of Worcester Polytechnic Institute. Mr. Thrasher has spent his entire life in the construction industry, starting with an eighteen month tour of duty with the Army Engineers in Europe during World War I. He joined the Daniel Construction Company eighteen years ago and has since directed the construction of such multi-million dollar projects as the Celriver Plant of Celanese Corp. of America, at Rock Hill, S. C., the Singer Sewing Machine Company Plant, and the Owens-Corning Fiberglas Plant, both at Anderson, S. C.

**DEERING MILLIKEN'S HATCH MILL, NEAR TYRON, N. C., IS A PROJECT ON WHICH CARSON & LUNDIN WERE ARCHITECTS. THE OWNERS SUPPLIED THEIR OWN ENGINEERING DEPARTMENT, AND DANIEL CONSTRUCTION COMPANY WAS CONTRACTOR ON A FIXED FEE BASIS. THIS FULLY AIR CONDITIONED, WINDOWLESS, 220,000 SQUARE FOOT BUILDING WAS COMPLETED IN 217 CALENDAR DAYS FROM TIME OF GROUND BREAKING.**

engineer should urge the immediate selection of the general contractor.

From the start, the general contractor can be of inestimable help to both the owner and the engineer. During the preliminary design period, the contractor can assist the engineer in working out economies, in advising him of current practices and current costs, and in making studies of comparative costs of construction, thereby permitting the engineer and the owner to make the wisest decisions.

Because of the general contractor's familiarity with current practices and current costs and his close association with the engineer during the early design period, it is possible to get the construction program underway in much less time than if it had been necessary to wait for lump sum bids on the entire project.

Final details of the complete building plan are not required in order to begin construction if the engineer and contractor work together during the design period. Experience has shown that at least six months can be saved in bringing a major plant into operation when the engineer and contractor are both selected at the beginning of the project and construction is permitted to start as soon as plans for the foundation have been completed.

The advantage of engineer-contractor cooperation is one of the major selling points of design-construction organizations offering a complete service and a single responsibility. It is evident, however, that any competent engineering firm can offer equal service if the general contractor is also selected early in the operation. This arrangement has a further advantage in that a single company will not be inspecting its own work. The areas of responsibility in the owner, architect-engineer, contractor relationship must, of course, be carefully and clearly defined. But, unlike the single contract arrangement, it becomes possible under this working agreement for the owner to exercise single, over-all responsibility and still be able to work with the engineer and contractor of his choice. The engineer and the general contractor, both commissioned by the owner because of their skill and experience in their particular field, can then work together as a team to the best advantage of the job to be done.

The contracting firm's ability to get things done provides a practical "construction department" for the engineer throughout the design period. The engineer is free to concentrate his energies on the parts of the project for which he is best suited. He enjoys the benefits of the contractor's knowledge on those aspects of the job in which the contractor is best qualified.

Savings in both time and money made possible under such an arrangement are not difficult to cite. On a million dollar lump sum project, as much as

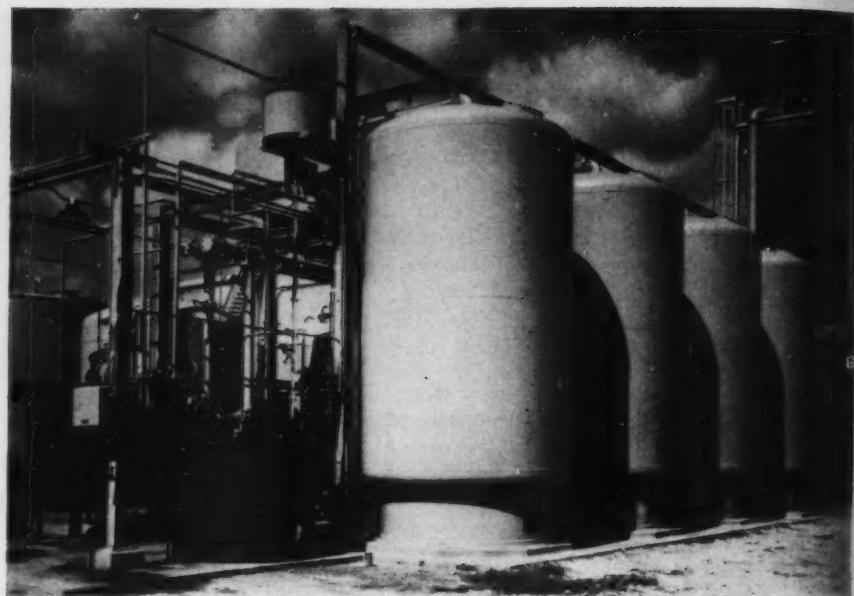
(Continued on page 66)

ECONOMICAL and efficient completion of any major construction project depends upon the co-ordinated efforts of the owner, the designing engineer, and the general contractor. Consultations between their organizations should begin in the early stages of preliminary design and continue until the project is completed and ready for occupancy by the owner of the plant.

Contrary to popular opinion, the "lump sum bid" job by the general contractor does not necessarily contribute to desired economy and speed. Estimating a major project is a very complicated and costly procedure. It requires expensive time and careful study, not by one but by several contracting firms. Since these bids are costly, the owner requesting a lump sum job actually pays the cost of unsuccessful bids as well as the successful one in his contract. This cost, although indirect, is reflected in the higher overhead of construction firms. Any uncertainty during the estimating phase raises a doubt in the estimator's mind and he will naturally tend to "play safe" in his bid. Additional expense and delay result if changes made in the building plans during the course of construction must be fully estimated and adjustments made in the original lump sum bid.

For greatest economy and speed, the general contractor, with his fee negotiated on a fixed basis, should be brought in at the same time as the designing engineer. For his own help and protection, the

DEMINERALIZATION AND SILICA REMOVAL PLANT AT LARGE OIL REFINERY HAS FOUR HYDROGEN CATION EXCHANGER UNITS AND DEGASIFIER AT EXTREME RIGHT.



## Industrial Ion Snatchers . . . Cation and Anion Exchangers

ESKEL NORDELL, Administrator of Laboratories  
The Permutit Company



Eskel Nordell has spent over 34 years in the water treatment field and has gained wide experience in laboratory, plant, and industry-wide application work. A chemist by training, he understands the water problems connected with the chemical and process industries and has actively worked in many fields such as ceramics, plastics, rubber, dairy, textile, oil and gas, brewery, pulp and paper, laundry, municipal, and power plant. He was formerly

W.O.C. consultant on water treatment, War Production Board; and General Manager, Water Softening Division, The Wayne Company.

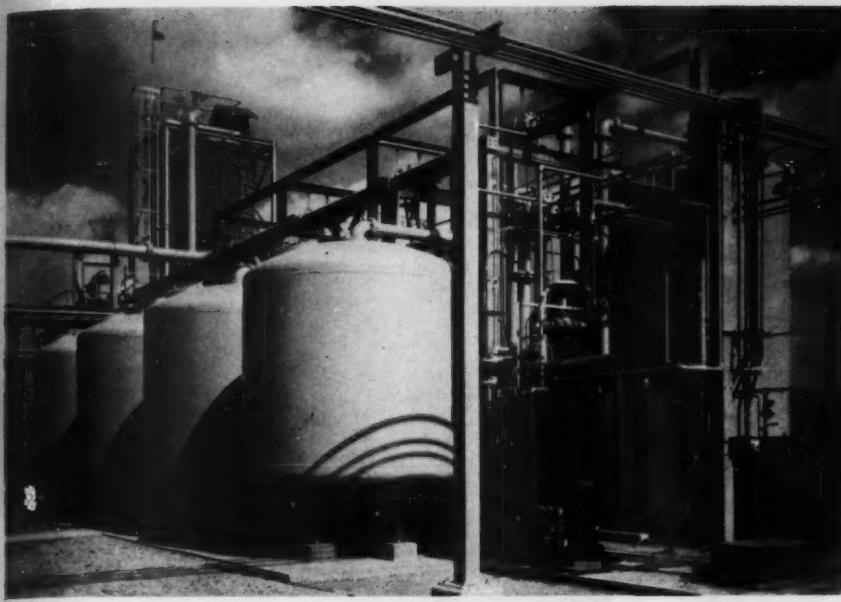
Mr. Nordell is the author of "Water Treatment for Industrial and Other Uses," a well rounded study on water problems, published by Reinhold Publishing Corporation. Hundreds of comprehensive articles, on all aspects of water conditioning, have appeared under his by-line.

IN THE LIGHT of the present wide usage of ion exchangers, it is remarkable that a century and a half elapsed between the discovery of the first cation exchangers and their practical application to water treatment and that another thirty years went by before anion exchangers were applied. It started in 1756 when Cronstedt, the Swedish geologist, discovered a group of natural minerals which, from the fact that they intumesced and gave off water when heated, he named "zeolites" from the Greek words "zein" and "lithos" meaning "boiling stone." Chemically, these zeolites consisted of a base, alumina, silica, and water of composition or hydration.

After their discovery, almost a hundred years passed before Professor J. Thomas Way, chemist to the Royal Agricultural Society of England, discov-

ered that the zeolites had base exchange (cation exchange) properties. His research work, the results of which were published in the 1850 and 1852 volumes of the Society's *Journal*, were initiated by the discovery of H. S. Thompson, an English farmer. In 1847, Thompson found that a filter composed of common garden soil removed ammonia from a solution of fertilizer. Then, assisted by a chemist, J. Spence, he found that while the ammonia was absorbed, an equivalent amount of lime was given up to solution.

Six years later, H. Eichhorn, a German chemist, discovered that these reactions were not only reversible, but could be reversed any number of times. That is, a sodium zeolite could be changed to a calcium zeolite, which in turn could be changed back to a sodium zeolite, and so on *ad infinitum*.

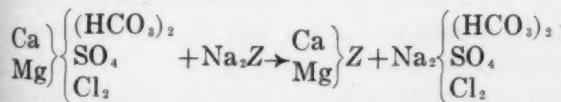


THESE FOUR ANION EXCHANGER UNITS ARE INSTALLED AT THE PLANT SHOWN ON THE PREVIOUS PAGE. THE INSTALLATION HAS A DESIGN CAPACITY OF 1600 GPM.

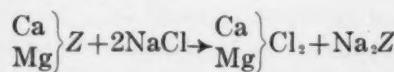
Quite a large number of investigators worked with these zeolites and published information on them and their role in geology. But except for an unsuccessful attempt by Harms and Rumpler to purify sugar beet juices with zeolites, no one saw any practical applications for nearly another half century. Then, about 1905, Robert Gans, a German chemist, decided to experiment with zeolites for softening hard water. His resultant research established that: (a) a columnar bed of granular sodium zeolite would soften hard water so completely that there was scarcely a detectable trace of hardness in the effluent, (b) when the water softening capacity of the bed was exhausted, it could be regenerated to its original activity by simply treating it with a solution of common salt, and (c) the cycle of alternate water softening runs and regenerations could be repeated indefinitely.

The chemical reactions involved in the softening and regeneration, using the symbol Z for the zeolite radical, may be indicated as follows:

Water softening reactions...



Regeneration reactions...



During the softening process, calcium and magnesium cations are taken out of solution by the insoluble zeolite granules which simultaneously give in exchange an equivalent amount of sodium cations. The net result is that the soap-destroying and scale-forming calcium and magnesium salts have been replaced by equivalent amounts of the corresponding sodium salts. These sodium salts are extremely

soluble, do not form scale, and do not destroy soap.

In the regeneration, the solution of sodium chloride, reacts with the exhausted calcium and magnesium zeolite, to restore the original sodium content to the zeolite and simultaneously to remove the calcium and magnesium in the form of their soluble chlorides. A simple rinse removes these and the excess salt used, and discharges them to the drain, leaving the rinsed zeolite ready to soften a further equal quantity of hard water on the next run.

Gans also invented a fusion process for making synthetic zeolites on a commercial scale. Furthermore, he designed the zeolite water softener in which these reactions could be carried out in a practical and economical manner. From the Latin word "permutare", meaning to interchange, he coined the word "Permutit" for these synthetic zeolites and, at first, the water softening process was known as "Permutizing" and the product as "Permutized Water." In common usage, however, the name "zeolite" was used for the synthetic products, the water softening process became known as "the zeolite process," and the softened water as "zero hardness water" or, more commonly, as "zero water."

This water softening process soon came into widespread use. In laundries, textile mills, industrial plants, homes, or any place where soap is utilized, this process effects enormous detergent savings which, depending on the hardness of the water supply being softened, range from 20 to as much as 80 per cent. Also, water softened by this process eliminates scale formation in steam boilers, water heaters, hot water piping, and fixtures, and thus provides large savings in labor, repairs, and replacements.

Another great advantage of the zeolite water softener is its extreme simplicity of operation. It does not require dosing with measured amounts of chemicals proportioned to the hardness and flow rate of

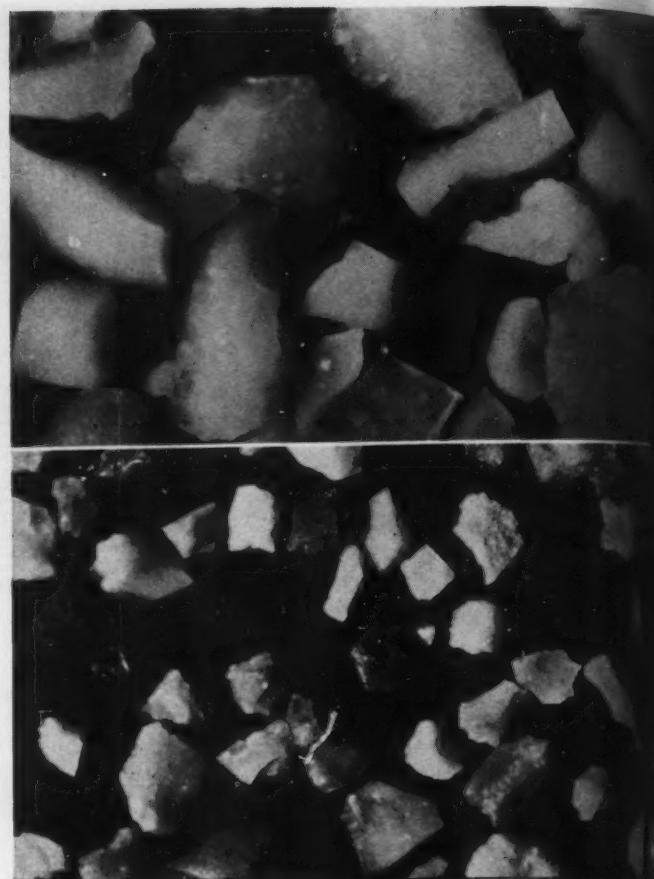
the raw water. Instead, all that is necessary is to flow the water, usually downward, through a bed of the sodium zeolite and, at intervals as required, regenerate it with a solution of common salt. All of these operations may be controlled automatically, and such arrangements have come into extensive use.

#### Inorganic Cation Exchangers (Zeolites)

Inorganic cation exchangers are commonly known as "zeolites" and as they are all complex double silicates, they are also known as "siliceous cation exchangers." They may be classified as: (a) synthetic fusion type, (b) synthetic wet or gel type, (c) green-sand or glauconite type, and (d) clay type.

**Synthetic fusion type.** This was the first commercial zeolite. It was made by fusing together felspar, kaolin, sand, and soda ash; cooling; crushing and screening to size; and leaching out the soluble by-products. This material had a water softening capacity of somewhat over 4.0 kilograins (as  $\text{CaCO}_3$ ) per cu ft. It was rather slow in its exchange reaction and was superceded some thirty years ago by faster reacting and more rugged materials.

**Synthetic wet or gel type.** The white synthetic zeolites are made from: (a) solutions of sodium silicate, sodium aluminate, and aluminum sulfate, or (b) solutions of sodium aluminate and sodium silicate. As first formed, they set to a solid gel. This gel is filter-pressed, and then put through a special, carefully controlled drying process. From this it emerges in the form of hard, horny chunks which, when dropped into water, decrepitate into angular particles, the great bulk of which are of the correct size for use. Coarser particles are crushed to size and fines are removed by wet screening and hydrau-



TOP PHOTOMICROGRAPH SHOWS GEL TYPE SYNTHETIC ZEOLITE  
BOTTOM, SILVER ZEOLITE, IS USED FOR DESALTING SEA WATER

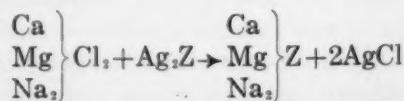
#### TYPICAL RATINGS OF SODIUM CATION EXCHANGERS

Sodium cation exchangers	Salt consumption lb per kilogram	Capacities kilograins per cu ft
Greensand (standard)	ind 0.5	3.0
	ind 0.45	2.8
	ind 0.4	2.5
	hhld 0.67	3.0
Greensand (high capacity)	ind 0.5	5.5
	ind 0.45	5.0
	ind 0.4	4.4
	hhld 0.67	6.0
Synthetic zeolite	ind 0.5	10.0
	ind 0.45	9.0
	ind 0.4	8.0
	hhld 0.67	12.0
Carbonaceous	ind 0.45	7.0
	hhld 0.8	10.0
Resin A	ind 0.5	14.0
	ind 0.45	13.0
	hhld 0.55	16.0
Resin B	ind 0.5	27.0
	ind 0.45	26.0
	ind 0.4	25.0
	ind 0.3	22.0
	ind 0.275	20.0
	hhld 0.45	24.0-26.0
ind-industrial ratings		hhld-household ratings

lic grading. The finished material, as shipped, weighs about 54 lb per cu ft and the screen size is 16 to 50 mesh. Exchange capacity, depending on the amount of salt used per regeneration, ranges between 8 and 12 kilograins (as  $\text{CaCO}_3$ ) per cu ft.

Two other special zeolites, Folin zeolite and silver zeolite, are made from synthetic wet or gel type zeolites. The Folin zeolite is made from finely divided gel type zeolite by an acid and leaching process. It is used in laboratories for determining ammonia by the Folin method.

Silver zeolite, which is used in making briquets for desalting sea water and thus rendering it suitable for drinking purposes, is made from a synthetic gel type sodium zeolite by treatment with silver nitrate. Briefly, when this is in contact with sea water, it reacts with the chlorides of sodium, magnesium, and calcium as follows:



Since the sodium, calcium, and magnesium zeolites and the silver chloride are insoluble, a simple



MANGANESE ZEOLITE, TOP, IS USED FOR ANALYTICAL PROCEDURES.

GLAUCONITE ZEOLITE, BOTTOM, IS KNOWN AS GREENSAND.

filtration serves to remove them. If sulfates are also to be removed, some barium hydroxide is incorporated in the briquets.

It is possible to make wet or gel type synthetic zeolites with other amphoteric metals than aluminum in their composition. The only commercial one ever manufactured, however, was an iron double silicate and that was withdrawn from the market many years ago.

**Greensand or glauconite type.** The correct geological name for the natural raw material used in the manufacture of this type of cation exchanger is glauconite but it is more commonly known as greensand. Greensand is a marine deposit, which was formed and is still forming on the ocean bottom, around the continental shelves at depths of from 700 ft to 2 miles. Large deposits, formed during the Cretaceous Period, are found in a comparatively pure form, in the New Jersey marl beds.

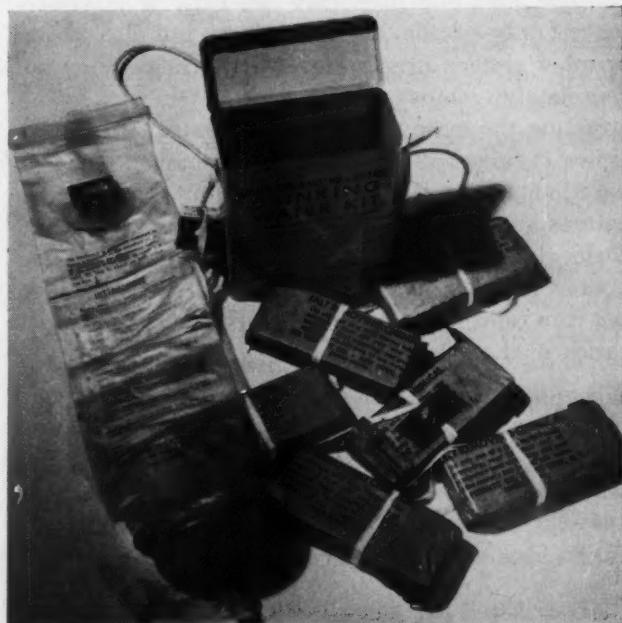
It occurs in the form of small, botryoidal particles, ranging in size from practically colloidal material up to granules about  $1/10$  in. in diameter. The raw material is put through an elaborate refining, stabilizing, and screening process from which it emerges

in the form of hard, round, grayish green granules screening between 15 to 50 mesh and weighing about 81 lb per cu ft. Exchange capacity of standard greensand zeolite ranges from 2.5 to 3.0 kilograins (as  $\text{CaCO}_3$ ) per cu ft.

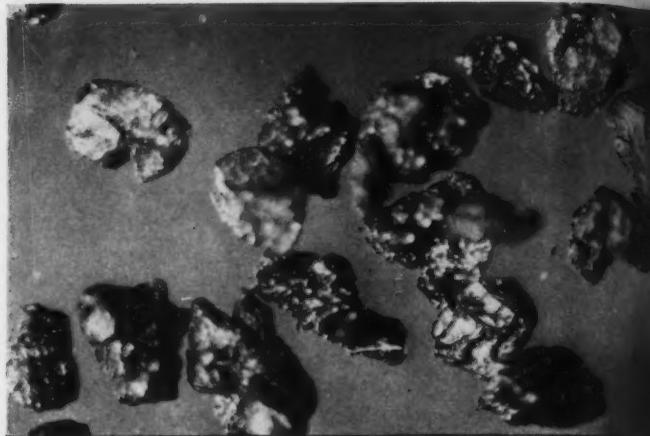
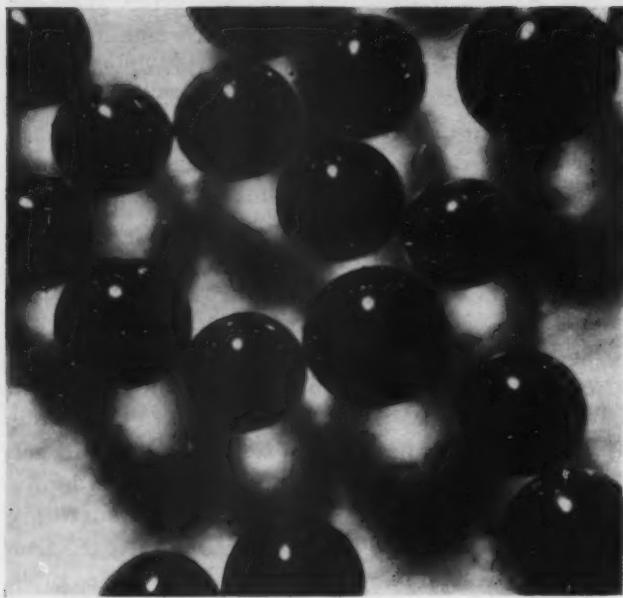
By a different method of processing in which the material is roasted in a reducing atmosphere, digested in caustic soda solution, and stabilized with aluminum sulfate and sodium silicate, a high capacity greensand zeolite is produced. Its capacity ranges from 4.4 to 5.5 kilograins (as  $\text{CaCO}_3$ ) per cu ft.

So-called "manganese zeolite" is made from processed greensand by treating it with manganous sulfate and potassium permanganate. It is not used as an ion exchanger but is used for removing iron and manganese from water. When waters containing ferrous bicarbonate or manganous bicarbonate are filtered through a bed of manganese zeolite, the iron and manganese are oxidized to insoluble hydroxides, which then are removed by the filtering action of the bed. The bed is backwashed at intervals to remove these deposits and, before its oxidizing capacity has been completely used, it is regenerated with a solution of potassium permanganate. Manganese zeolite is a black, granular material, screening 16 to 50 mesh and weighing about 98 lb per cu ft. In industrial practice, its use is generally limited to waters with 1 ppm or less of iron or manganese.

**Clay Type.** These zeolites are made from certain types of clays which are usually weathered, then ground, treated with caustic soda, formed into "noodles," baked, and "rehydrated" in a caustic soda solution. The "noodles" are made in two sizes,  $1/8 \times 1/8 \times 1/4$  in. and  $1/16 \times 1/16 \times 1/4$  in. By cracking and screening, a granular type may be produced. The



EACH BRIQUET TREATS ABOUT A PINT OF DRINKING WATER.



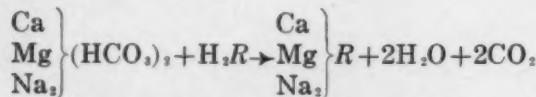
CARBONACEOUS TYPE, ABOVE, AND RESIN TYPE, LEFT, CATION EXCHANGERS ARE ORGANIC MATERIALS WHICH CAN BE USED FOR EITHER SODIUM CYCLE OR HYDROGEN CYCLE OPERATION

finished materials weigh about 35 to 70 lb per cu ft, and exchange capacities range from 4.0 to 7.0 kilograins (as  $\text{CaCO}_3$ ) per cu ft. Clay type zeolites are now used to only a very limited extent.

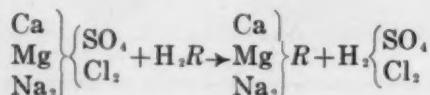
#### Carbonaceous and Resin Type Cation Exchangers

About thirty years after Gans' discovery of the water softening properties of inorganic, siliceous zeolites, it was discovered that certain organic materials had cation exchanging properties and that these could not only be used on the sodium cycle but also on the hydrogen cycle. On the sodium cycle, these materials are regenerated with common salt and used in the same manner for softening water as the inorganic, siliceous zeolites. On the hydrogen cycle, they are regenerated with an acid, usually sulfuric acid, and then they are capable of removing not only calcium and magnesium but also sodium or other cations from water. Furthermore, they will completely remove the bicarbonates for, by abstracting the cations from bicarbonates, all that remains is carbon dioxide, which is removed easily by aeration. In reacting with sulfates or chlorides, the cations are removed and equivalent amounts of sulfuric and hydrochloric acids are formed. The reactions may be indicated as follows, using the symbol R to represent the complex organic radical of the cation exchanger:

With bicarbonates...



With sulfates and chlorides...

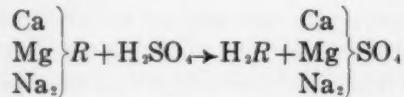


As most natural water supplies contain some sulfates and chlorides, the effluent from a hydrogen cation exchanger unit is usually acid and requires either neutralization or acid removal. Neutralization may be accomplished by the addition of measured amounts of caustic soda or soda ash or by mixing the effluent in proper proportions with the effluent from a sodium cycle cation exchanger.

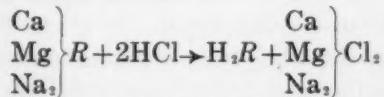
When an alkali is used for neutralization, the usual arrangement of equipment is: (a) hydrogen cation exchanger unit or units, (b) degasifier to remove carbon dioxide, and (c) alkali feeder. When the effluent from a sodium cation exchanger is used for neutralization, the usual arrangement is: (a) hydrogen cation exchanger unit or units, (b) sodium cation exchanger unit or units, and (c) degasifier to remove both the carbon dioxide formed in the hydrogen cation exchanger and by neutralization.

At the end of the hydrogen cation exchanger run, the bed is regenerated with either sulfuric or hydrochloric acid. Regeneration reactions may be indicated as follows:

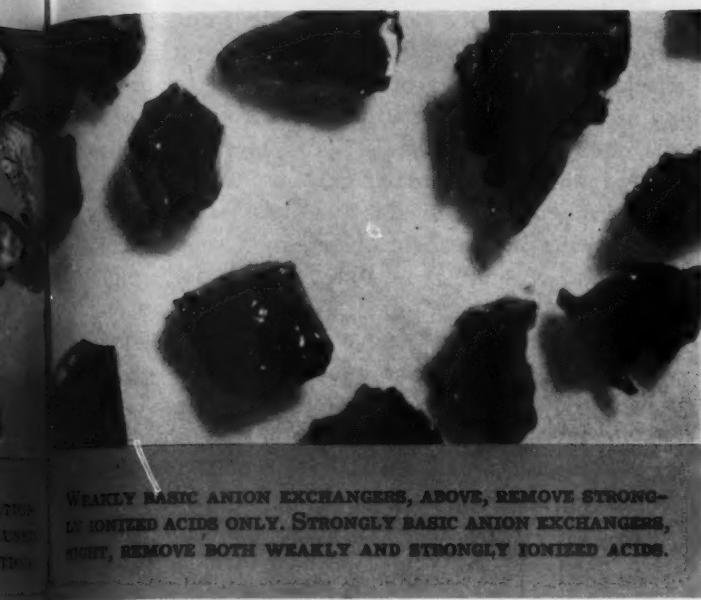
With sulfuric acid...



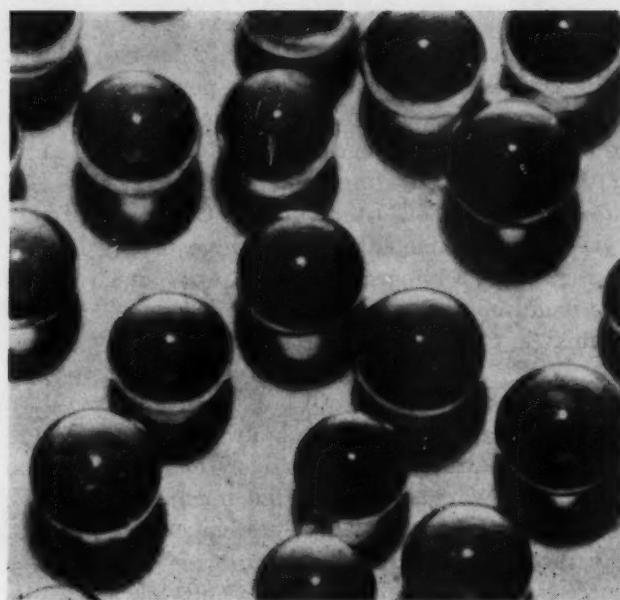
With hydrochloric acid...



It will be noted that when sulfuric acid is used as the regenerant, one of the by-products formed is calcium sulfate, which has a rather limited solubility. In order to avoid precipitation of calcium sulfate in the bed, it is necessary to use the sulfuric acid at a strength not greater than 2 per cent. While car-



WEAKLY BASIC ANION EXCHANGERS, ABOVE, REMOVE STRONGLY IONIZED ACIDS ONLY. STRONGLY BASIC ANION EXCHANGERS, RIGHT, REMOVE BOTH WEAKLY AND STRONGLY IONIZED ACIDS.



bonaceous type cation exchangers may be fully regenerated with this dilute acid, resin types are not fully regenerated. If hydrochloric acid is used as the regenerant, all of the by-products formed are extremely soluble and it is possible to use the acid at 15 per cent strength, which will fully regenerate any type of cation exchanger. Hydrochloric acid, however, is usually much more expensive, on an equivalent basis, than sulfuric acid. Therefore, sulfuric acid is the most widely employed regenerant, and with the resin type cation exchangers, this simply means operating them at a lower capacity.

It is possible to use 2 per cent sulfuric acid for the first part of the regeneration and stronger acid for the second part, but this is seldom practiced. It is also possible to regenerate with salt and then follow this with a regeneration with a stronger solution of sulfuric acid, but such a procedure is not economical.

**Carbonaceous type.** These materials are very widely used both on the sodium and hydrogen cycles. They are manufactured by careful sulfonation of a certain type of coal with fuming sulfuric acid, and are black, granular materials, screening from 16 to 50 mesh, and weighing about 30 lb per cu ft. They contain mostly sulfonic groups, which will react with the bicarbonates, sulfates, and chlorides, and also a certain amount of carboxyl groups, which on the hydrogen cycle will react with the bicarbonates but have little or no effect on the sulfates or chlorides. For industrial use and when regenerated with 0.45 lb of salt per kilogram, the capacity is 7.0 kilograms (as  $\text{CaCO}_3$ ) per cu ft. When larger amounts of salt are used, as in household practice, the capacity is 10 kilograms (as  $\text{CaCO}_3$ ) per cu ft.

Carbonaceous cation exchangers may be used with a great variety of waters as they are unaffected by low pH and produce satisfactory results at pH values as high as 9.5. Also, they may be used with

iron or manganese bearing waters to remove these metals together with the hardness. Being nonsiliceous in nature, they obviate all danger of a silica pick-up. Another advantage is that if the bed should get coated with iron or calcium carbonate deposits, as sometimes happens when handling an iron-bearing water or in handling a lime treated water, it may be cleaned easily with acid.

On the hydrogen cycle, carbonaceous cation exchangers are readily regenerated with a 2 per cent solution of sulfuric acid. The acid consumption is 0.25 lb of 66 deg Be sulfuric acid per kilogram of compensated cations, and the exchange capacity is 8 kilograms (as  $\text{CaCO}_3$ ) per cu ft.

**Resin type.** The most widely used types of resin cation exchangers are sulfonated synthetic resins, and their cation exchanging properties are principally due to the sulfonic groups introduced by the sulfonation process. Synthetic carboxylic resins are also made. However, the carboxyl groups on the hydrogen cycle react only with bicarbonates, and they are of little or no value in removing cations from sulfates or chlorides. Sulfonated resins used in water treatment may be broadly divided into the phenolic and nonphenolic or styrene types.

**Phenolic type resins.** Cation exchange resins of the phenolic type are sulfonated phenol formaldehyde products which have been crushed and screened to size 16 to 50 mesh. They are dark reddish brown in color, have a shipping weight of about 24 lb per cu ft, and have an exchange capacity on the sodium cycle ranging from 13.0 to 16.0 kilograms (as  $\text{CaCO}_3$ ) per cu ft. On the hydrogen cycle, when regenerated with dilute sulfuric acid, they are usually operated at an exchange capacity of 10 kilograms (as  $\text{CaCO}_3$ ) per cu ft.

**Styrene or nonphenolic type resins.** These cation exchangers are sulfonated styrene base products in

the form of small spheroidal beads screening from 16 to 60 mesh. They are amber in color and have a shipping weight (moist) of 55 lb per cu ft. On the sodium cycle, exchange capacity ranges from 20.0 to as high as 35.0 kilograins (as  $\text{CaCO}_3$ ) per cu ft, but the usual operating range is from 20.0 to 27.0 kilograins (as  $\text{CaCO}_3$ ) per cu ft. On the hydrogen cycle, the exchange capacity ranges from 11.0 to as high as 40.0 kilograins (as  $\text{CaCO}_3$ ) per cu ft, but the usual operating range is from 11.0 to 25.0 kilograins (as  $\text{CaCO}_3$ ) per cu ft.

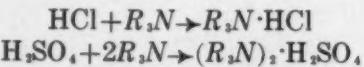
#### Anion Exchanger Resins

With the exception of the hydrogen cycle reaction on bicarbonates, cation exchangers have no effect on the anions, which pass through unchanged. On the sodium cycle, for instance, equivalent amounts of the bicarbonate, sulfate and chloride ions, with a corresponding amount of sodium ions, are left in the effluent. On the hydrogen cycle, while the metallic cations have been removed and the bicarbonate anion breaks down into carbon dioxide and water, equivalent amounts of the sulfate and chloride ions, as sulfuric and hydrochloric acids, are left in the effluent. These ions may be removed by synthetic resin anion exchangers of a basic nature which may be broadly classified as: (a) weakly basic type, and (b) highly basic type.

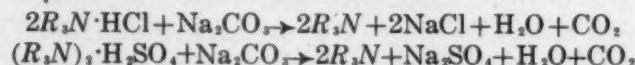
**Weakly basic type resins.** Weakly basic anion exchangers may be used to remove strongly ionized acids such as sulfuric and hydrochloric but will not remove weakly ionized acids such as carbonic and silicic. One typical material is aliphatic amine anion exchange resin, consisting of reddish brown granules, screening from 10 to 60 mesh, weighing 17 lb per cu ft, and having an exchange capacity of 14.0 to 19.0 kilograins (as  $\text{CaCO}_3$ ) per cu ft. They are usually regenerated with soda ash but either caustic soda or ammonium hydroxide also may be used.

Using the symbol  $R_3N$  for the complex radical of the weakly basic anion exchanger, the reactions involved in the removal of hydrochloric and sulfuric acid may be indicated as follows:

Water softening reactions...



Regeneration reactions using soda ash...



If removal of silica is not required, then water may be demineralized by the following arrangement of equipment: (a) hydrogen cation exchanger unit or units for removing calcium, magnesium, sodium, and other cations, (b) weakly basic anion exchanger unit or units for removing the sulfuric and hydrochloric acids formed from the sulfates and chlorides by the hydrogen cation exchanger, and (c) degasi-

fier for removing the carbon dioxide formed from the bicarbonates by the hydrogen cation exchanger.

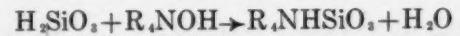
**Highly basic type resins.** Anion exchangers of this type may be used to remove both strongly ionized acids such as sulfuric and hydrochloric and also weakly ionized acids such as carbonic and silicic. A typical exchanger material is quaternary amine polystyrene resin, in the form of amber colored, spheroidal beads, screening from 10 to 50 mesh, and weighing 40 lb per cu ft as shipped. Its exchange capacity ranges from 9.0 to 14.0 kilograins (as  $\text{CaCO}_3$ ) per cu ft. Strongly basic anion exchangers are regenerated with caustic soda.

Using the symbol  $R_4N$  for the complex radical of the highly basic anion exchanger, typical reactions may be indicated as follows:

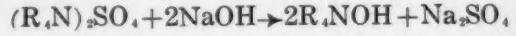
Removing strongly ionized sulfuric acid...



Removing weakly ionized silicic acid...



Regeneration using the sulfate as an example...



Chloride, nitrate, carbonate, and silicate are removed in a similar manner by regeneration with caustic soda which removes the acids in the form of their sodium salts and simultaneously restores the anion exchanger to its original state.

#### Demineralization

By using highly basic anion exchanger units in connection with hydrogen cation exchangers, a very complete removal of all mineral matter including silica and carbon dioxide may be effected.

There are a number of different arrangements of demineralization equipment such as: two step with degasifier, two step without degasifier, mixed bed, three step with degasifier, four step with degasifier, and cation exchanger with mixed bed and degasifier. The choice as to which arrangement is best suited to solve a specific problem depends on a number of factors among which are the composition of the raw water, the end requirements of the effluent for its specific use, the volume of water to be treated over a given period, the peak flows required, the cost of treatment, and the equipment costs.

#### Other Uses for Ion Exchangers

In addition to the use of ion exchangers in water conditioning, an ever widening field of other applications is rapidly developing. Briefly, some of these uses are in sugar refining, recovery of metals, treatment of wastes, fractionation of the rare earths, recovery of alkaloids, purification of various organic materials, manufacture of catalysts, modification of milk, separation of amino acids, internally for hypertension and stomach ulcers, purification of vitamins, and various analytical procedures.



Macomber

ONE PREFAB MAKER EXCLUDES BOLTS AND RIVETS BY LOCKING STEELWORK TOGETHER SIMILAR TO A BEDSTEAD.

More prefabricated buildings for industry, commerce, and government, went up last year than ever before. Engineers are finding that in addition to offering speed and economy, the prefabs also permit important reductions of valuable engineering planning time.

## The Prefab Mushroom

By HENRY F. UNGER

THE PREFAB building business is far beyond its diaper stage, and is growing bigger every day. One prefab maker estimates that his business has increased nearly 5000 per cent since 1941, and as yet, no end to this growth is in sight.

But what are prefabs? Actually they come from a new concept in industrial and commercial construction which is pushing into every corner of America's economy. In simple terms, they are pre-designed, permanent, steel-frame structures constructed from standardized units and shipped to a location as a single package.

Examples of prefab buildings are found throughout the country and in almost every type of endeavor. Such companies as Soule Steel Co., of Los Angeles; Butler Manufacturing Co., of Kansas City, Mo.; Luria Engineering Co., of New York City; Steelcraft Manufacturing Co., of Rossmoyne, Ohio; Macomber Inc., of Canton, Ohio; and Trucson Steel Div. of Republic Steel Corp., Youngstown, Ohio, are turning out these compact buildings to be used for industrial plants, foundries, petroleum installations, ware-

houses, hangers, and scores of other uses.

Not only are prefabs getting a popular acclaim in the small building field, but large industries are applauding their benefits and buying them in increasingly larger quantities.

Typical of a big job is the \$3 million factory completed for the Willard Storage Battery Co. in Allentown, Pa. This building, fabricated by Luria Engineering Corp., is 250 ft in width and 520 ft in length, with an eave height of 16 ft. In addition to the main factory, which has masonry walls and a concrete floor, there is a brick-steel-framed office building in front, and a 2000 sq ft acid storage building in the rear. A total of 497 tons of structural steel went into the plant. E. C. Machin, Inc. and H. F. Everett & Associates handled the job as general contractor and architect.

In another interesting example, the New York Central Railroad is using four steel-aluminum prefabs as diesel locomotive service and repair shops. The four, single-roof shops cover an area totaling 130,400 sq ft. Applications such as this, where constant vibration and sulphur-bearing smoke quickly



SIDE VIEW OF THE WILLARD BATTERY PLANT ILLUSTRATES THE DESIGN FLEXIBILITY PROVIDED BY PREFABRICATORS.

Luria

damage buildings of standard construction, are expected to prove the stamina and long-life economy of prefabricated construction.

Behind the prefab makers is the idea that they must perform a good job in the shortest possible time. Speed of erection is a big factor in their favor.

#### Speed of Erection

Pre-engineered buildings are quickly erected because the components are precut and prepunched for easy field assembly. Butler Mfg. Co. even prepunches the sheeting material and ships their sheets pre-cut for such irregular places as the gable and wall, and around doors and windows. This company also prepunches the structural framework for easy bolted connection in the field, thus eliminating field welding.

An interesting example of erection speed is the one-story building recently built in Silver Spring, Md. and now being used by U. S. Geological Survey as a map-distribution center. It comprises 40,000 sq ft, and was manufactured by Macomber, Inc. This manufacturer uses a simple locking device to eliminate bolts and rivets. The building was erected entirely by local workers who had never seen the interlocking steel framing before. Assembly of the 59 ton frame, with columns spaced for 20 ft bays, required 398 man-hours. Placing Macomber high-rib-section metal decking on the roof framing required another 252 man-hours.

Windows in the building were placed in groups of three, separated by ornamental brick panels. Aluminum siding was used between the windows and the roof. To further reduce construction cost, the aluminum sheets were nailed to steel girts, visible in the

illustration below. Total cost of the building, including cost of a concrete retaining wall at one edge of the property, was less than \$4.50 per sq ft. Due to the short, four-months total construction period, the owner also realized savings in financing charges. Arthur Myers was the consulting engineer.

To demonstrate ease of erection, Macomber requested that workmen use only two hammers and two adjustable wrenches to assemble a 40 x 40 ft steel frame warehouse for Shanafelt, Canton, Ohio. Four unskilled workmen, timed by engineers from the U.S. Army, Corps of Engineers, completed the instal-



ASSEMBLY OF THE 59 TON FRAME FOR THIS BUILDING IN SILVER SPRING, MD. REQUIRED 398 MAN-HOURS.

Macomber



THIS MODERN OFFICE FRONTS THE \$3 MILLION PREFAB FACTORY BUILT FOR WILLARD STORAGE BATTERY CO.

Luria

lation in only one hour and forty minutes.

In many companies, ordinary maintenance men have assisted in the erection of prefabs. The men, already on the payroll, oftentimes derive considerable satisfaction from the fact that they have built a steel building. Typical of such an operation was a building erected for the Columbus Stove Co., Columbus, Ohio. The 80 x 400 ft building, with a crane runway, was assembled in three days. Eight men were used. Cost, including the use of a crane, totaled \$800.

Since many variable factors enter into the cost of erection, it is difficult to quote an exact figure. One

company estimates that buildings can be erected on existing foundations at a cost of 17 to 60c per sq ft.

Because components of the buildings are pre-engineered and standardized, assembly-line techniques can be used in their manufacture.

To understand how fast these buildings can be made, Butler Mfg. Co. received an order from Peter Kiewitt Son's Co., general contractors for the giant atomic energy plant now under construction in Pike County, Ohio. Within 55 days the company shipped and completely erected 89,000 sq ft of building space for varied uses at the site.

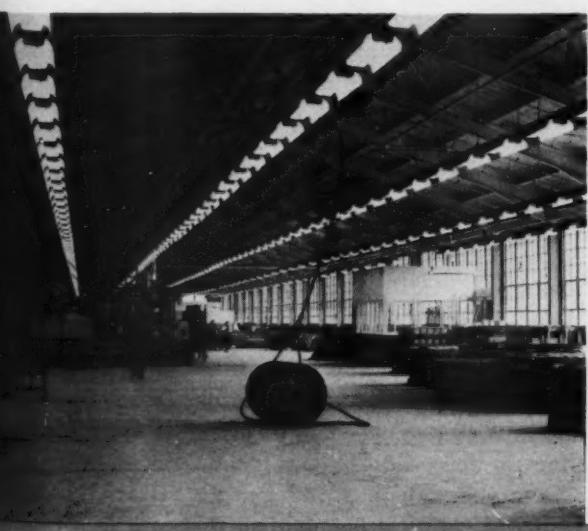
Steelcraft Co. shipped two buildings totaling 28,000 sq ft to California Packing Co. within 45 days after receipt of the order.

#### Flexibility of Design

Salient feature in the prefab construction field is the flexibility of design. Although various companies call their equipment standard, there is always complete freedom of building design and architectural treatment. This is important since architects and engineers reserve the right to do their own designing with any company's products. With standard bays and five structural components, any engineer can design a structure to meet the needs of his client.

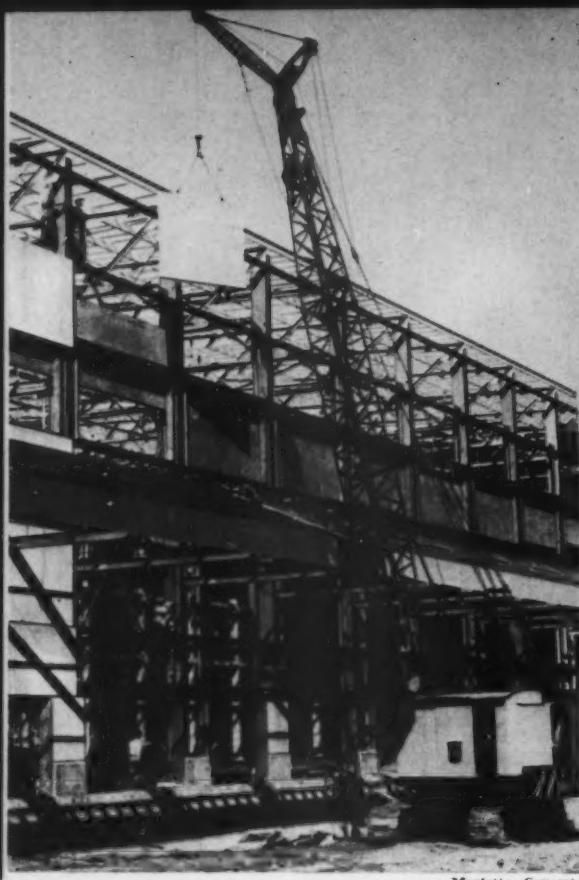
Different designs are available as standard, but with a slight field or shop modification, they can be varied as to height, width, or length. Most of the buildings can be easily insulated, and there is always a choice of door and window sizes and locations. One of the prefab builders uses the standard byword, "adaptability unlimited," to emphasize this flexibility.

Examples are numerous. Butler engineers design



Luria

INTERIOR VIEW AT WILLARD SHOWS HOW STANDARD BAYS WERE COMBINED TO MEET A SPECIFIED 250 FT WIDTH.



Marietta Concrete

PRECAST CONCRETE WALL PANELS BEING SET IN PLACE AT UNION CARBIDE'S MARIETTA PLANT.

various buildings to use similar or identical parts. The roof purlin is identical on all buildings from 20 to 70 ft wide. Wall sheet used for the sides of any particular height of building can be made identical, regardless of width.

Luria units are available in widths of 32 to 100 ft, eave heights of 12 to 20 ft, and any desired length in increments of 20 ft. Units of the same or different widths can be combined in any desired multiple arrangement. Doors and windows can be located wherever desired. Optional features such as skylights add to the flexibility of design.

Soule Steel Co. furnishes buildings and erects them in standard widths of 32, 40, 50 and 70 ft clear span. The bays are 20 ft each. Heights vary from 10 to 24 ft at intervals of two ft. The purchaser is thus offered a wide choice of standard structures to meet his requirements. Cost can be reduced by selecting available widths, lengths, or heights.

In prefab buildings, the accent is on producing a rugged, permanent building at a minimum cost. As an example, Luria buildings are fabricated from heavy, rolled-steel sections, engineered to meet the most exacting building codes.

#### Economies of Manufacture

Without sacrificing quality, economies of manufacture are effected as a direct result of pre-planning. The Z-section used by Butler as roof purlin on all of its various building widths, serves to illustrate this



Luria  
STANDARD WIDTH BAYS FORM THIS 495,000 SQ FT WAREHOUSE, BUILT BY U. S. AIR FORCE ENGINEERS AS PART OF A TRAINING PROGRAM.

point. According to the company, most of their purlins are made of .084 in. thick, high tensile strength material. It is bought in flat coil stock, uncoiled, and cold formed into a 6 in. deep Z-section with 2½ in. flanges. One 20 ft long purlin weighs only 60 lb, but has a load-carrying capacity of 2074 lb.

Butler has another example of efficient use of materials in their method of producing rigid frames. The company welds their tapered sections, using three plates. By using plates instead of trying to split a standard structural section, the company can produce its material in decimal thicknesses to accurately meet stress requirements.

Recent steel shortages have brought the element of less waste into sharp focus. Since all of the structural components arrive at the job prefabricated and ready to erect, there are no left-over parts or modifications required in the field.

#### Reduced Planning Costs

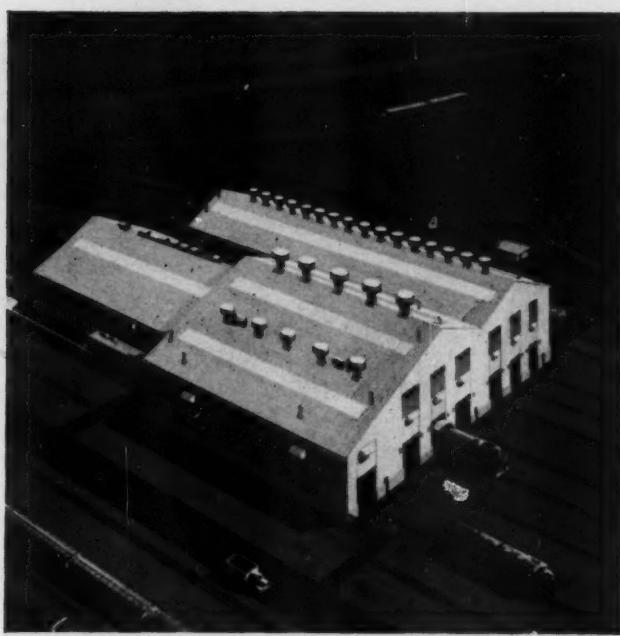
Of particular interest to consulting engineers are the reduced costs in the original planning stage. Complete details, showing all fabrications, are furnished to the designer for immediate use, thus reducing drafting room expense. Standard catalog sizes also reduce planning time. To illustrate this point, Macomber offers standard bay sizes of 20 x 20, 20 x 30, and 20 x 40 ft. These can be arranged with either the short or long side to the front to meet almost any property dimensions. Macomber claims that the 20 ft module is most economical for a ratio of depth to span, in the support of roof loads, or as a beam between columns.

Important to remember and stressed by the pre-



Butler

SEPARATE UNITS CAN BE ASSEMBLED IN A HURRY  
TO PROVIDE ECONOMICAL STORAGE FACILITIES.



Luria

DIESEL REPAIR SHOP BUILT FOR NEW YORK CENTRAL  
ILLUSTRATES VERSATILITY OF THE PREFAB INDUSTRY.

fab makers is the fact that even after years of use as a permanent building, the entire structure can be quickly dismantled and moved to a new location without loss of material. In addition, it can be readily expanded or adapted to a new use. If more room is needed, the owner has but to extend the building with standard parts. Panels, doors, and windows can be rearranged easily to meet the changing requirements. Obsolescence is never a problem.

Still another factor in favor of the prefab manufacturers is the opportunity to test new designs before actual construction, as contrasted to other building methods where faults sometimes do not appear until years after the structure is completed. Similar to the procedure followed by equipment manufacturers, many prefab makers build pilot models of new designs. These can then be thoroughly tested, and the manufacture and assembly of component parts can be checked prior to actual production.

#### Prefabricated Panels

Closely related to the prefab manufacturers are the makers of prefabricated building sections. Examples of these are the manufacturers of doors and window sash, and prefabricated wall panels.

Precast concrete wall panels were recently used in the erection of what will be one of the nation's largest industrial plants, the Electro Metallurgical Div. of Union Carbide & Carbon Corp. at Marietta, Ohio. The panels, developed and manufactured by The Marietta Concrete Corp. as non-load bearing walls, employ laminated construction in which  $1\frac{1}{2}$  in. of rigid insulation separates two  $1\frac{3}{4}$  in. concrete layers. Wire mesh is imbedded in each layer of con-

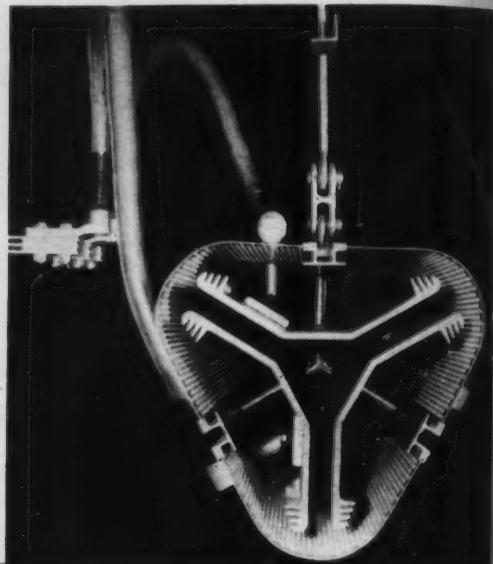
crete. Panels are cast in steel forms by a production line method, trucked to the job, and put in place by cranes. Inserts cast in each panel, together with clip angles and clamps, provide adjustable and positive fastening devices. Tongue and groove joints insure water-tightness and act as a self-aligning medium.

Insulated metal wall panels also are receiving increased acceptance because of savings in construction costs. The light weight construction permits further economies in the building frame or supporting structure. Since walls of 60 ft or more can be erected without horizontal joints, they are of particular advantage in the construction of powerhouses, steam plants, warehouses, auditoriums, and other buildings where high expanses of unbroken wall surface are common. An example of this type of construction, combining attractive appearance with construction economies, is found in a steam plant recently built for Northern Michigan Electric Co-operative, Inc., Boyne City, Mich. Insulated metal walls with galvanized steel exterior plates, manufactured by The R. C. Mahon Co. of Detroit, were used for virtually all exterior walls. Architectural and engineering work on this project was handled by Stanley Engineering Co., Muscatine, Iowa.

Prefabrication in the construction industry has rightfully earned its place. For the purchaser, it offers the many inherent advantages of pre-engineering. For the engineer, it offers a constructive saving of time. In addition to the more obvious savings in planning time, the engineer can be assured that since practically all of the building material comes from one source, it will be of uniform quality and will present fewer construction problems in the field.



SHEET ALUMINUM HOUSING ENCLOSES SIX INCH ALUMINUM CHANNEL BUS AT HIWASSEE PLANT, TVA. ALL BUS JOINTS ARE WELDED.



END-VIEW OF THREE ALUMINUM CABLES TAPPED TO SECTOR BUS AND ENCLOSED.

## Aluminum in Electrical Construction

R. R. COPE  
Development Engineer  
Aluminum Company of America

A NUMBER OF FACTORS have led the electrical industry to turn to aluminum. Its conductivity, combined with its forming and handling characteristics, its corrosion resistance, light weight, and lower price make it a logical conductor material. As a construction material in substations and towers, its corrosion resistance, strength-weight ratio, and formability have often made aluminum the logical choice. There are a host of applications in component parts of electrical equipment where aluminum may enter as a conductor or a structural material and where specialized characteristics may make it particularly suitable.

### Aluminum Conductor

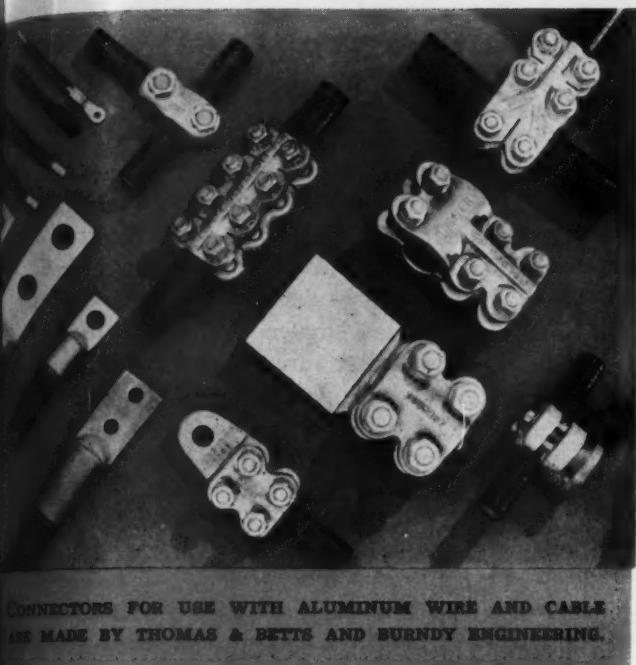
The prime electrical conductor uses for which aluminum has been applied are bare and weather-resistant overhead conductors, insulated power cable, bus conductors, magnet wire, and small stranded conductor for aircraft, automotive, and lighting cable. Each of these uses involves application of electrical conductor grade aluminum, called "EC" aluminum, although in some instances alloys are being used.

EC has a minimum purity of 99.45 per cent, and

Aluminum has shown spectacular growth as a material of electrical construction. However, it should be realized that aluminum wiring or bus requires its own design and its own installation technique, different in many ways from those used with copper.

a conductivity equal to 61 per cent of International Annealed Copper Standard. Other factors being equal aluminum wire must have a cross sectional area 1.59 times that of copper conductor to give the same voltage drop when carrying the same load. But, with a specific gravity of 2.70 compared to copper's 8.89, aluminum conductors of size sufficient to give equal conductance are only 0.483 the weight of the comparable copper conductor. Resistance of aluminum and hard-drawn copper wire are two AWG numbers apart; hence, a No. 12 aluminum wire has the same direct current resistance as a No. 14 copper wire. Like copper, tensile strength of aluminum wire depends upon the amount of cold work involved.

Selection of temper depends to a large extent upon the service of the conductor. Most multi-strand cable is manufactured from ASTM Spec. EC-H19 material, with a tensile strength from 25,000 to 30,000 psi, depending on size. Where higher flexibility and



CONNECTORS FOR USE WITH ALUMINUM WIRE AND CABLE  
ARE MADE BY THOMAS & BETTS AND BURNDY ENGINEERING.

workability are desired, intermediate tempers are available. In general, aluminum insulated wire No. 8 or smaller utilizes an intermediate temper so that tensile properties range from 17,000 to 22,000 psi. These tempers are chosen so that the aluminum wire has comparable flexibility to the equivalent copper conductor.

#### Wire and Cable

Applications of aluminum to the wire and cable field are not new. Aluminum wire and cable have been carrying current for more than fifty years, with some of the oldest installations still in service. In 1908, aluminum-steel combination was first utilized for a 33,000 volt line. ACSR (aluminum cable, steel reinforced) now dominates the high-voltage field. Over 2,000,000 miles of cable have been installed in the United States alone. ACSR is used on 80 per cent of all line conductors operating over 150,000 volts. A seven-strand, all aluminum cable in regular service today was installed in 1899, while the use of insulated cable for power and feeder circuits goes back to 1905. Aluminum bus conductors were first applied in 1896.

Aluminum's entry into the building wire field has been relatively recent. In September 1946 the Underwriters' Laboratories granted approval for the use of rubber-covered aluminum conductors. This approval covered wires in sizes No. 12 and larger, now being produced by a number of manufacturers. Aluminum Company of America has employed such conductor widely, their Davenport, Iowa plant being an example of a major installation.

Upon completion in 1948, Alcoa's Davenport rolling mill was the most complete demonstration of the application of aluminum to all phases of construc-

tion that had ever been designed. With the exception of structural steel framework and transmission towers, it is "all aluminum" down to the chain link fence surrounding the mill. Despite Alcoa's obvious interest in furthering aluminum applications, it was specified only where particular advantages in weight, cost, physical properties, ease of erection, and maintenance, or other factors were indicated.

The electrical applications of aluminum in that plant are immense. An all aluminum distribution system was designed to serve the 60,000 kw plant connected load. Approximately 1800 miles of aluminum wire and cable ranging from No. 12 to 1250 mcm were installed as well as over 100 miles of aluminum conduit from 0.5 to 5 in. Some 6800 aluminum lighting fixtures were installed. The design of an aluminum, low-reactance, triangular sector bus for heavy, 440 volt feeders is one of the unique features.

The entry and growth of aluminum in any of the conductor fields has been the result of combined technological and economic factors. Aluminum did not begin to attain its present position of dominance in the high voltage transmission field until the commercial development of ACSR in 1911. The combination of aluminum with steel gave the highest strength-weight ratio of any cable, and savings were brought about by the use of longer spans. Then, aluminum became the choice for power and feeder cable when its price advantage made such a choice almost mandatory.

An electrical design section was established by Alcoa to exploit the properties of ACSR, and to create a technology in handling, stringing, supporting, and terminating ACSR. Specialized hardware was developed. Five years ago Alcoa established an electrical conductor branch of the Aluminum Research Laboratories at Massena, New York. These facilities have been constantly engaged in research to derive more information on properties and technological problems concerning aluminum wire and cable. Today, most of the problems in the transmission field have been solved.

However, the solutions to connection and termination problems with overhead conductor work are not universally applicable to insulated cable. Fitting sizes must be scaled down because of space limitations. Major research is being undertaken to provide efficient means of termination with minimum space consumption. New mechanical and pressure connectors are the major developments.

Because of the larger diameter of aluminum wire, insulated cable demands more insulation with the consequent increase in total cable dimension. Though the economics of aluminum give it a price advantage even with greater insulation consumption, space factors are often important. Aluminum systems should be designed from the start of building plans rather than from an existing copper system. Such procedure will allow the use of specialized

techniques for handling aluminum conductor to reduce the disadvantage of larger conductor sizes.

Alcoa has pioneered in the use of aluminum wiring in its plants at Davenport, Iowa, Point Comfort and Rockdale, Texas, and at Vancouver and Wenatchee, Washington. The latest example of this wiring is in Alcoa's new ultramodern Pittsburgh office building. Pressure connection was employed for conductors up to 350 mcm; larger cables were welded. For bolted and pressure connectors, a petrolatum joint compound is used to seal against oxidation and to insure long lasting, low resistance connections. This method is effective for either aluminum-aluminum or aluminum-copper joints.

#### Bus Conductor

Aluminum bus systems had almost a half-century history of constant service at Niagara Falls, New York, before the Alcoa plant located there was shut down. These high-purity bus bars demonstrated excellent corrosion resistance characteristics. In over 40 years, attack depth averaged 0.006 in. on exposed surfaces and averaged 0.001 in. on other surfaces. Such attack is insignificant.

The millions of pounds of bars installed during the past few years has netted Alcoa a vast increase in technical knowledge on joining. Experience gained from these large installations has proven the adaptability of aluminum alloy plus bar bolts, silver-coated contact surfaces, and steel and bronze bolts with cup washers.

A new, three-phase, Y-shaped feeder bus of specially shaped extruded bars, first used at Davenport, is a striking feature of the new Alcoa building. Two of these busses rise vertically through the building's 30 stories. Power is tapped from them at every floor. The important features of the new bus are low reactance and improved voltage efficiency from advanced design features, weight saving of 45 per cent over conventional copper bus, and large cost savings through lower metal consumption and easier installation.

Aluminum bus conductor of rectangular cross-section is most commonly used, and is available in a wide range of sizes and lengths. Multiple-bar rectangular bus systems provide relatively large surface area for heat dissipation. Joints and taps are readily made by overlapping, and except for occasional special construction, bending and forming of the flat bars are simple operations. Bolted connections make excellent joints if the proper techniques of cleaning, putting on a compound, and applying pressure are used. Argon arc welding for bus connections is a particularly satisfactory technique.

Tubular bus, made in standard pipe sizes, has a number of advantages, particularly for outdoor substations and switching stations. Its shape gives equal rigidity in all directions, an advantageous property in withstanding the effects of ice, wind, and short cir-

cuit loads. Symmetrical cross section greatly facilitates bending to form turns and offsets without the use of specially designed bending tools. The cylindrical surface is effective in preventing corona discharge at high voltage. Skin effect characteristics are good.

In 1928 Alcoa introduced aluminum channel bus. This consists of two aluminum channels forming a hollow ventilated square. It has particularly low power losses and is practical for large a-c and d-c currents, especially those above 2000 amps per circuit. It approaches the electrical efficiency of a split tube but has the advantage of flat surfaces for making taps and connections as well as the structural rigidity and strength associated with a girder.

All aluminum cable bus is in use in some locations. In addition, occasional installations require round rod bus, but this type is not efficient for large alternating currents because of skin effect.

#### Conductor Applications

Transformer winding is one of the newest applications of aluminum electrical conductor. The results of 3½ years of tests on 20 specially constructed transformers have been released. Performance under the severest conditions has been excellent. Techniques for joining were successfully developed during the fabrication period; no problems were encountered with these connections during the entire test. Workmen winding the transformers preferred the flat, glass-insulated aluminum wire because of its lightness and ductility, which makes the formation of rectangular coils easier. Over-all weight, dimensions, and electrical characteristics are practically identical to copper. G. E. has built several hundred transformers with aluminum windings in sizes from 5 to 33 kva and for voltage classes to 15,000 volts.

Applications of aluminum as a conductor material in large synchronous machines, generators, and motors, both large and small, are increasing. Definite economic advantages result from the use of cast aluminum rotors for motors ranging from fractional horsepower types to large squirrel cage induction motors. By using alloys of varying conductivity, cast rotors are produced to meet the various electrical requirements of the motors of these types.

Field coils and armature windings are another aluminum conductor application. Though the space factor has limited such uses, engineers and designers are taking a new look at aluminum for such applications because of its inherent lower cost.

Applications of aluminum to protective equipment take advantage of both its structural and conductor properties. Lightning arrestors and relays are typical examples.

Telephone cable is one of the newer aluminum conductor applications. It is in wide commercial use at the present time.

Future possibilities exist in electrical equipment associated with internal combustion engines. Devil-

opments in magnet wire and insulation pose new applications for starter motors and controls and for ignition equipment. High-temperature insulations are solving the space factor and operating temperature problems. Research has indicated that a big new field in high-temperature applications may exist as a result of the relatively lesser effect of elevated temperature on the electrical characteristics of aluminum.

#### Non-Conductor Applications

Electrical construction uses of aluminum which utilize non-electrical properties are numerous. Towers, substations, and lighting standards take advantage of aluminum's weight, appearance, and corrosion resistance. Non-magnetic properties make it especially suitable as a component of many electrical items such as housings and enclosures.

Aluminum crossarms and masts or "goat heads" for transmission towers require no painting or maintenance. In industrial areas where corrosion is high, the extra cost of aluminum over galvanized steel in crossarms and structural numbers is more than saved through reduced maintenance expenditures. This factor—lower maintenance cost—has made aluminum desirable for substations in industrial and sea coast areas\*. Here are not only lower maintenance costs, but reduced risk to crews, and savings in the original construction costs.

Outdoor lighting standards are another aluminum application which has proven effective. A good appearance without painting and lower erection cost makes this an economic application. Large installations can be found in the Chicago Park District, Pittsburgh, New York City, Newark, Los Angeles, and Levittown, Long Island.

Aluminum as used for shielding cans and condenser cases is well known. Sheet, plate, and structural shapes are used for switchboards, control panels, bus enclosures, switch house roofs, and relay, starter, and control boxes. Sheet is used for switch, outlet, and junction boxes. Castings are utilized as fittings. Cast housings, bushings, and covers of aluminum are used for switches and controls.

Aluminum has been applied in transformer cases and cooling fins. It is used in housings and covers of large equipment where weight considerations are primary.

Aluminum conduit offers savings in most corrosive atmospheres, and in applications where appearance is of primary importance, aluminum conduit is valuable. It also has a price advantage over non-magnetic materials where this property is a controlling factor. Its light weight can reduce construction costs. Thus, both as a conductor and as a structural medium, aluminum has innumerable uses.

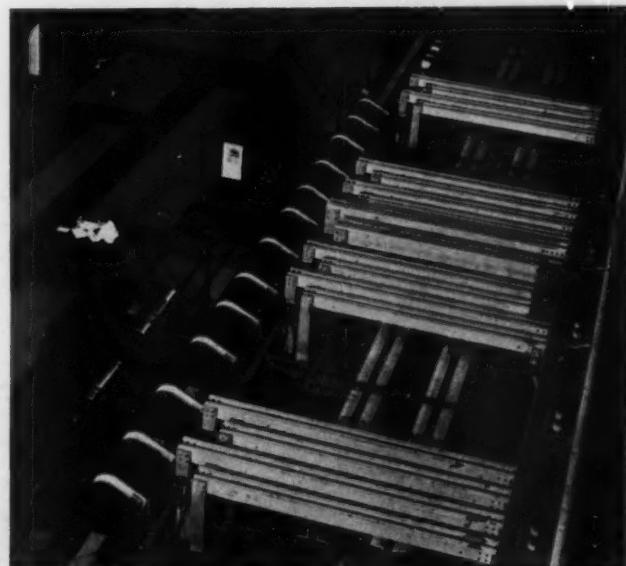
Two "rules of thumb" are the keys to success with aluminum conductor.

1. *Design it for aluminum.* No one attempts to design a metal bridge from plans for a wooden structure—the advantages of metal are not accounted for. The design of a copper electrical system takes advantage of copper's particular properties; an aluminum system should be designed to take advantage of aluminum's particular properties. Therefore, an aluminum electrical system should be designed initially for aluminum, rather than substituting aluminum in a previously designed copper system.

2. *Connect it properly.* More than any other problem, connecting has been aluminum's greatest challenge. Aluminum is readily, easily, and effectively connected—if properly handled. A clean joint, the use of compound where indicated, and adequate pressure are necessary. Joints involving aluminum to aluminum or aluminum to existing copper systems are always satisfactory if properly made. A wealth of technical literature dealing with connections is available from cable and fittings manufacturers.

The economics of specifying conductor are leading the engineer to aluminum. Aluminum technology is maturing; its history of trouble-free operation and low cost maintenance in all areas under all conditions has proven its suitability. The engineer who specifies aluminum is receiving a practical, economic product supported by a thorough technical background.

Spectacular growth has been the dominant theme of the aluminum industry. It has a place in markets formerly held by other materials, and it has not yet found a fraction of its future applications. In the years ahead it will be a material of electrical construction frequently specified by engineers.



THESE 250 V (FOREGROUND) AND 440 V D-C CONDUCTORS OF CHANNEL ALUMINUM ARE SHOWN AT THE DISTRIBUTION PANEL FOR AUXILIARY MOTORS AT J & L STEEL IN PITTSBURGH.

\*However, the copper alloys of aluminum are attacked by salt atmospheres and should not be used along the coast.



Armstrong Cork Co.

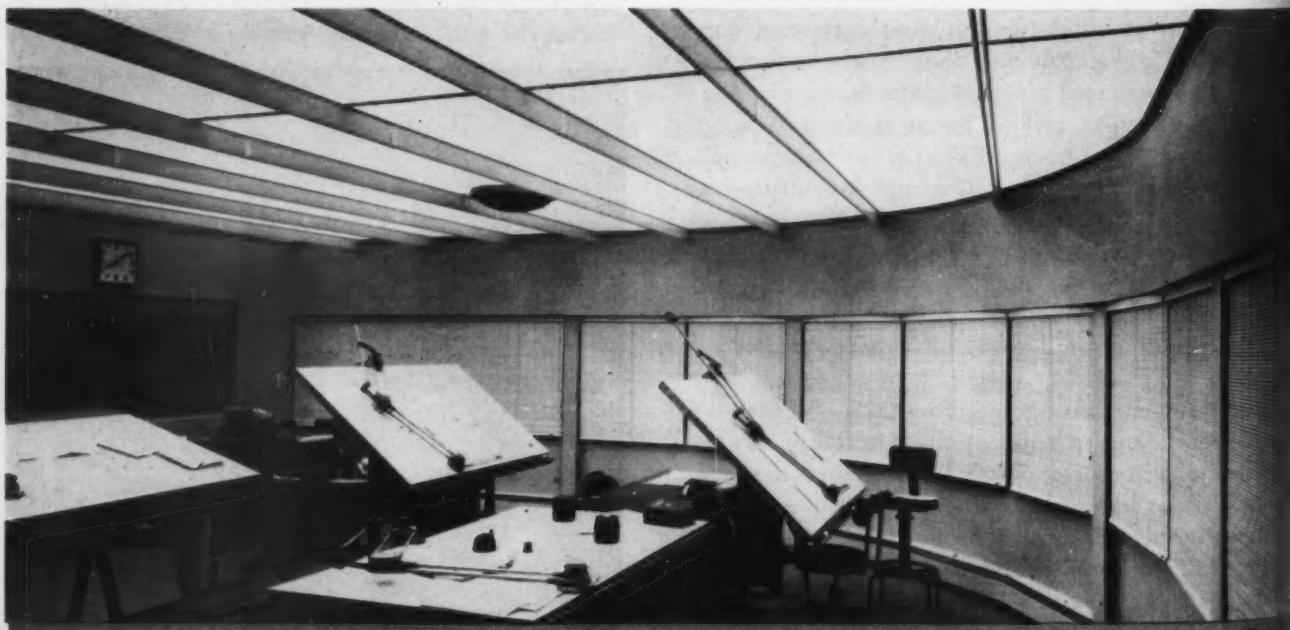
THE OFFICE OF THE MARSH STEEL COMPANY OF NORTH KANSAS CITY, MO., USES AN ACOUSTICAL TILE CEILING.

## Sound Conditioning Pays Several Ways

FRANCIS A. WESTBROOK

SEVERAL YEARS AGO the Aetna Life Insurance Company made extensive tests on the effect of noise on workers. Those tests still stand as the best statistical and scientific analysis of the comparative working efficiency of persons in rooms with and without acoustical treatment. The results were so conclusive as to the benefits of acoustical treatment that they remained uncontested. Since that time many sound condition installations have been made in all sorts of places — industrial plants, churches, restaurants, stores, banks, and offices — and without exception the results have been beneficial.

The Aetna Life Insurance Company tests, which covered a period of nearly two and a half years, were made in an office area known as the "control department". Machine operators, typists, and clerical checkers worked in this room. Records of the performance of all these employees were kept for a year



THIS DRAFTING ROOM HAS AN ACUSTI-LUMINUS CEILING. IT IS A NEW TYPE OF ACOUSTICAL TREATMENT WHICH NOT ONLY REDUCES THE NOISE LEVEL BUT SPREADS LIGHT FROM FLUORESCENT TUBES TO GIVE GLARELESS ILLUMINATION.

Luminous Ceilings Inc.

before installation of the acoustical ceiling and for another year after it was in place. This procedure showed an increase of 9.2 per cent in efficiency. Check tests, not quite as complete as the first, were made in two other rooms under similar conditions. In one the increased efficiency was 9.4 and in the other 7.7.

After the second year a further check test was made by covering the ceiling with rock sheeting, which rendered the acoustical treatment largely ineffective. The records then showed an immediate drop in efficiency. A record of errors was also kept. Typists had reduced errors 29 per cent when the acoustical ceiling was installed, but errors went up 12 per cent when it was covered. Similarly, business machine operators, who had reduced errors 52 per cent when noise was reduced, increased errors by 37 per cent when the noise was brought back. As these tests were made carefully, the only conclusion was: acoustical treatment is definitely beneficial. In addition, absenteeism was reduced by 37½ per cent and turnover by 47 per cent.

Aetna management decided that the advantages justified the expense of treating all the ceilings. This also included the departments that did not have enough constant noise to be fatiguing, because laboratory tests showed irregular noises also had a detrimental effect. Experience indicates that acoustical treatment has been substantially consistent with the results obtained by this company.

Acoustical treatments are employed for two purposes. First, there is the abatement of noise. This has a great many different applications, including its

use in industrial plants. Second is the treatment of auditoriums such as theaters, concert halls, and churches to provide for good audio characteristics. This means the absorption of reverberations so that it is possible to hear well in all parts of the room. The principles of physics involved are the same.

Ceilings and walls with hard surfaces reflect sound waves. These waves build up and overlap, resulting in excessive and confusing noises. However, if the sound waves strike an acoustically treated surface, they are broken up and mostly absorbed. Thus, there is no appreciable reflection of sound waves and a great deal less confusion of the noises coming from various parts of the room. Although the noise is not stopped at its source, the area seems much quieter, and fatigue resulting from noise is greatly reduced.

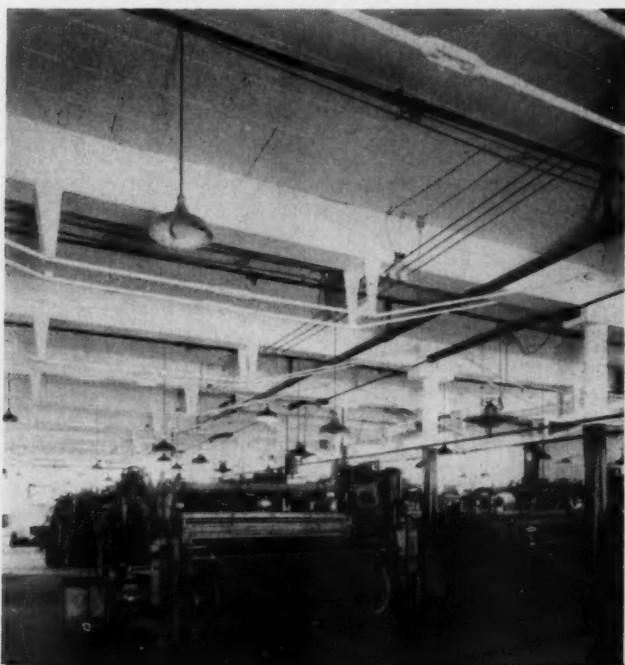
For special applications, unusual treatment is required. General Electric Company is now constructing at Pittsfield, Mass., a sound test building and special equipment, to be used to noise-test transformers. The sound chamber of the test building, 56 ft wide, 66 ft long and 49 ft high, will be the quietest room in the world for its size. Four and a half feet thick, double walls will make the chamber completely soundproof. The walls will be composed of concrete, Fiberglas, masonry, a layer of copper shielding, a 6 in. compartment of air space, and on the inside, 28 in. wedges of Fiberglas encased in wire cloth. A working surface will be provided by interlaced airplane cables held in place by 400 lb compression springs attached to the walls.

Purpose of the copper shielding in the chamber



Armstrong Cork Co.

AN ACOUSTICAL CEILING IN THE PRESS ROOM OF THE PHILADELPHIA INQUIRER HELPS REDUCE MACHINE NOISE.



Armstrong Cork Co.

ANOTHER APPLICATION OF ACOUSTICAL TILE IS IN THE CEILING OF THE WEAVING ROOM OF ABBOTT WORSTED CO.



The Celotex Corp.

DECORATIVE ACOUSTICAL TILE IN HEILMAN'S RESTAURANT, CLEVELAND, O.



Armstrong Cork Co.

ACCOUNTING OFFICE APPLICATION.

walls will be to prevent radio waves from interfering.

The sound test building, which will be ready for use early in 1954, was designed by Chas. T. Main, Inc., Boston, and is being constructed by the Gilbane Building Company, Providence, R. I.

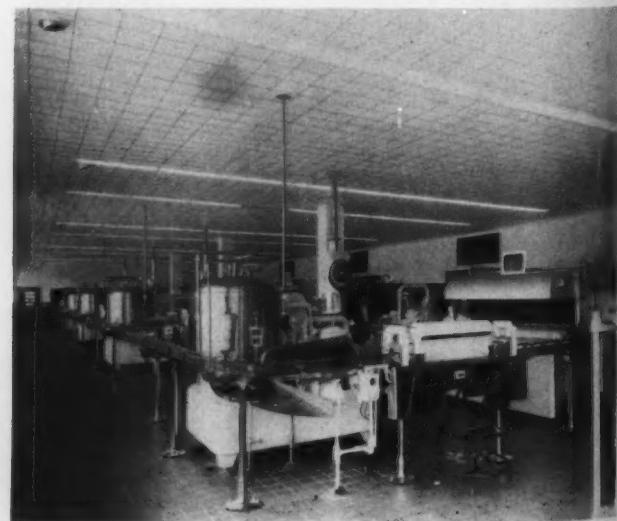
Such specialized design is not needed to reduce noise in conventional industrial and commercial buildings. Usually, treating the ceiling with commercially available tiles is sufficient, but where conditions are particularly severe, the sidewalls can be either covered in whole or in part with tiles.

Numerous acoustical materials, made by different concerns, are available. But selecting the right one for a given job is important. The material comes in the form of tiles, mostly with perforations, although a few, such as processed cork and fissured mineral wool tiles, are not perforated. Practically all can be cleaned and painted without loss of efficiency. Some are most effective for high frequency noise and others for middle frequencies. A few are said to be equally effective at all frequencies. The difference in cost and appearance provides some variety.



The Celotex Corp.

ACOUSTICAL TILE ON CEILING AND SIDEWALLS OF THE PRESSROOM, WALLA WALLA, WASH. UNION BULLETIN.



The Celotex Corp.

COCA COLA BOTTLING ROOM HAS AN ACOUSTICAL CEILING TO MINIMIZE NOISE OF BOTTLES MOVING THROUGH.



The Celotex Corp.

COMFORT AND EFFICIENCY RESULTED WHEN ACOUSTICAL CEILING WAS INSTALLED IN SWITCHBOARD ROOM OF RETAIL STORE.

There are numerous methods of applying the acoustical materials. They can be cemented directly to existing plaster or concrete ceilings or walls, nailed to wood furring strips, or installed on a suspension system. The best and most economical method depends on local conditions, and following the advice of the supplier is an excellent policy.

#### New Acoustical Design

In the past few months several newer types of acoustical ceilings have been put on the market. One of the most interesting is a special design developed by Luminous Ceilings Inc. Essentially, it consists of a false ceiling of thin, translucent, corrugated plastic. This is suspended by hangers from the frames of strip fluorescent lights mounted on the true ceiling above. The corrugated plastic is held in place by a series of crossbeams made of thin, perforated steel filled with a sound-absorbing pad. These crossbeams absorb the sound within the room while the translucent plastic spreads the light from the fluorescent tubes to give a high lighting level with low glare.

An interesting feature of this type of installation is that it can be installed to cover unattractive sprinkler systems. In the event of a fire, the plastic melts immediately and does not in any way interfere with the action of the sprinklers.

This Acusti-Luminous ceiling has been installed in a number of offices, commercial buildings, and drafting rooms. It is easy to install and reasonably priced.

Another new acoustical ceiling is designed to not

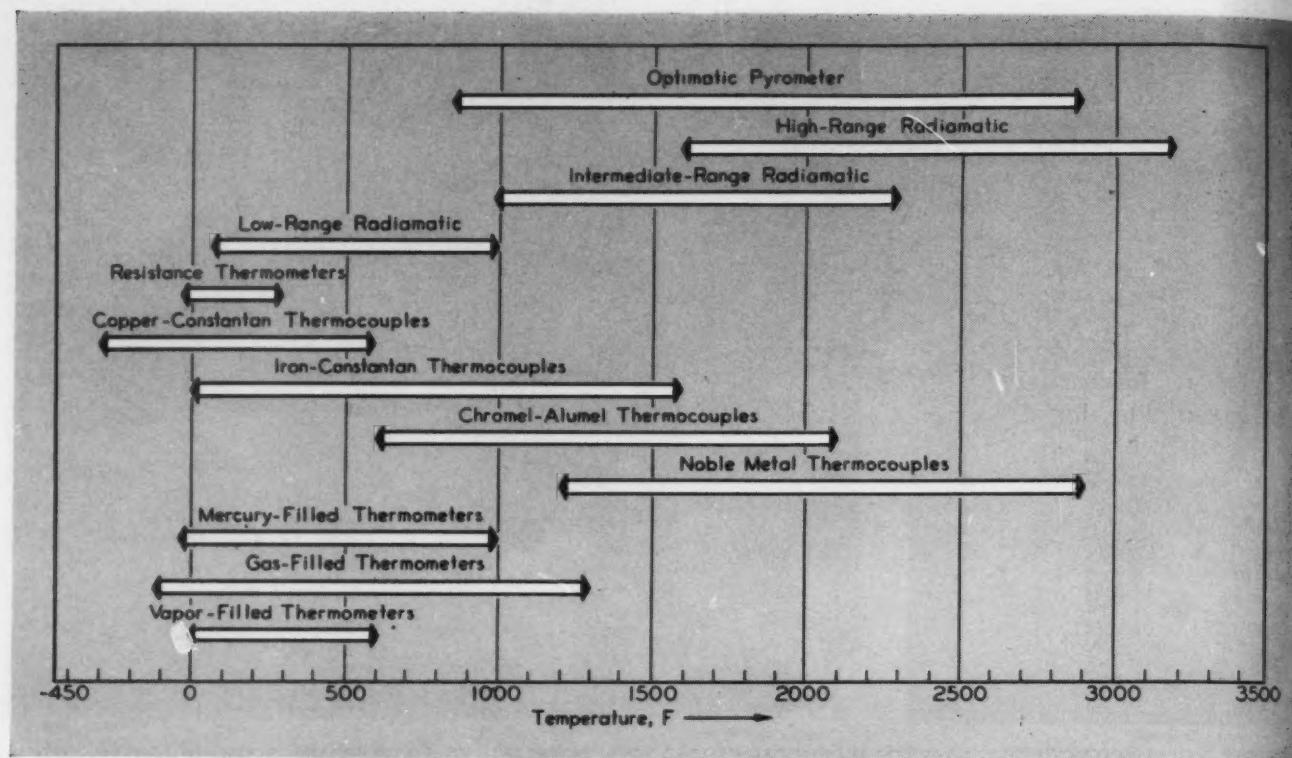
only reduce the noise level but to incorporate both radiant panel heating and radiant cooling. The entire surface of this Burgess-Manning ceiling radiates heat and distributes it throughout the room during the heating cycle. Conversely, during the cooling cycle the ceiling absorbs the heat radiated by the warmer objects in the room.

This ceiling consists of prefabricated, perforated metal panels clipped onto a coil system. Heat is conducted from the coils to the panel which in turn radiate heat to the objects in the room. Hot water is the circulating medium. An acousti-thermo blanket placed above the heating coils provides acoustical control and serves as thermal insulation. When cool water is circulated throughout the system, radiated heat from the room is absorbed.

#### Future Developments

It has only been within the past few years that engineers have paid much attention to the effects of noise upon worker efficiency. Now that more facts are known, there will be many more engineers and architects specifying sound conditioning as a part of industrial and commercial building design. Undoubtedly, there will also be many design variations and developments made commercially available.

*Editor's note: The Massachusetts Institute of Technology is holding a special summer course in acoustics August 24-September 4. (See "News" page 62). Also see story of acoustical treatment at Memorial Auditorium, Canton, Ohio, page 56.*



TEMPERATURE RANGES COVERED BY READILY AVAILABLE SENSING DEVICES CURRENTLY USED IN INDUSTRIAL PROCESS CONTROL. DEVICES HAVING OVERLAPPING RANGES EACH HAVE INDIVIDUAL CHARACTERISTICS OF MERIT.

## Techniques of Temperature Control

S. D. ROSS  
Minneapolis-Honeywell Regulator Company

**IN CONTROL PROBLEMS** of industry, temperatures may range from the extremely high values met in the manufacture of glass and alloy steels to the sub-zeros found in quick-freezing food processes and gas liquification. Control based on temperature poses a unique problem since thermal processes usually respond rather slowly to changes in heat input compared to the faster reactions in electrical, flow, pressure, and liquid level systems. However, adequate control of thermal factors can be achieved through the use of temperature-sensing devices and the associated transmission and instrumentation equipment.

### Sensing Devices

The four basic temperature-sensing devices in current use are pressure thermometers, thermocouples, resistance thermometers, and radiation pyrometers; they each offer characteristics of merit for many situations. The familiar glass-stem weather thermometer has its industrial counterpart in the

rugged metallic thermometer. A fluid fill within the closed thermometer system expands and contracts in response to temperature variations in the vicinity of the bulb thereby actuating the indicator.

Selection of a thermometer for temperature sensing involves consideration of these general factors:

- Overall error of the system is about plus or minus one per cent.
- Temperature must be within -125 to 1000 F.
- Distance from bulb to instrument cannot exceed 200 ft unless pneumatic transmission is used.
- Speed of response is good but is exceeded by that of a bare thermocouple; a pneumatic transmission unit can be selected to improve response time.
- The capillary tubing must be protected by conduit or similar means.
- While all common methods of pneumatic control are available, only the simpler electrical control modes can be used.
- Thermometer systems are inexpensive.
- Thermometers operate independent of external power sources.
- Thermometer bulbs are relatively large and cannot be placed in confined spaces.

Thermocouple pyrometers (properly termed thermocouple thermometers) are basically composed of two dissimilar metal wires joined in a circuit; a small d-c voltage is generated by the difference in temperature between the measuring junction and the reference junction. The voltage thus developed is proportional to the measuring junction temperature, the reference junction being kept at (or compensated for) some constant temperature. The generated voltage is converted to a scaled temperature reading on a millivoltmeter, or it can be fed to a potentiometer for recording or controlling or both.

There are literally thousands of variations of thermocouples based on wire combinations, insulation types, protecting tube assemblies, and the end use of the thermocouple's generated voltage. The application of thermocouples and thermocouple pyrometers should take account of the following:

(a) The errors are relatively low, from  $\frac{1}{4}$  to 1 per cent.

(b) The range of temperatures is wide from -300 F to almost 3000 F.

(c) The reference junction and instrument can be located a considerable distance away from the point being measured, permitting centralized observation of many stations in a large installation.

(d) The response speed of a bare thermocouple is quite high and certain types of protected thermo-

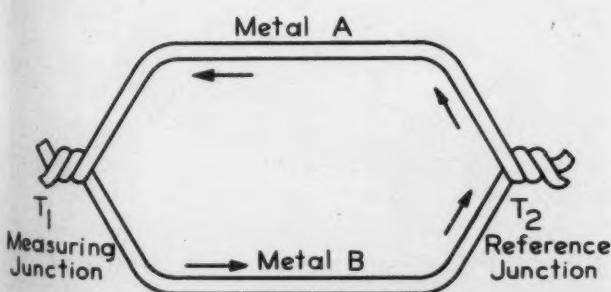
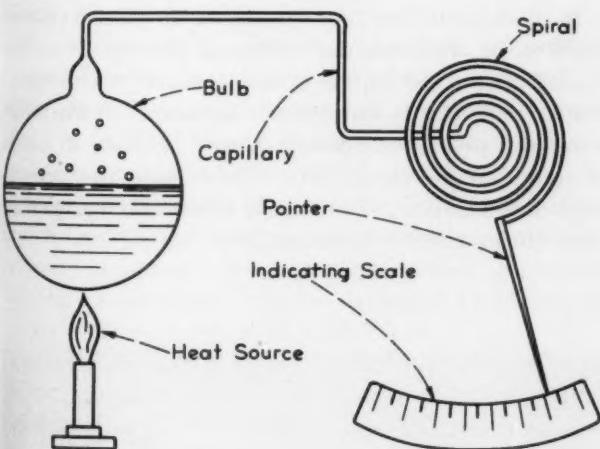
couples are also very fast.

(e) Thermocouples are easily replaced and easily calibrated.

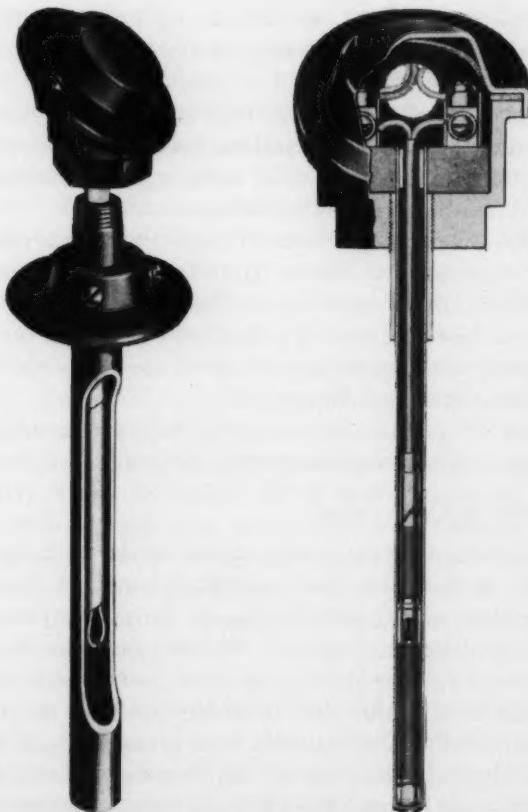
(f) Millivolt pyrometers provide inexpensive control and will indicate independent of external power sources.

Resistance thermometers make use of the property of most metals to change their electrical resistance as a result of temperature change. A resistance element, say a nickel wire wound on an insulating core to form a resistance thermometer bulb, is connected as one arm of a Wheatstone bridge circuit. The resistance thermometer bulb is placed at the point where temperature is to be measured. The bridge becomes unbalanced from the temperature changes around the bulb creating difference voltages which are detected by a bridge meter and converted to temperature values.

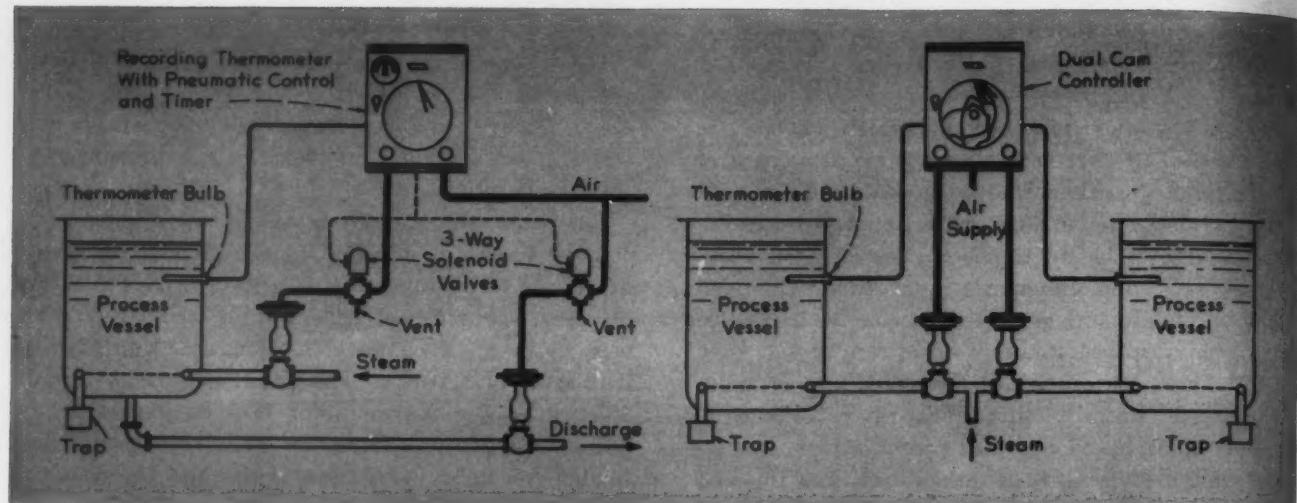
Bulb assemblies are available in many styles, including high response and high sensitivity models exceeding formerly-acknowledged limitations. Resistance thermometers are quite accurate, about 99 per cent over the range -20 to 300 F with higher and lower limits being attainable with some sacrifice in accuracy. Bulbs can be replaced easily although they are more costly than thermocouples. The bulb can be separated from its instrument by as much as 1000 ft.



BASIC STRUCTURES OF TWO SENSING DEVICES; THERMOMETER (ABOVE) AND THERMOCOUPLE (BELOW).



THERMOCOUPLE (LEFT) AND RESISTANCE THERMOMETER BULB (RIGHT) INSTALLED IN PROTECTING TUBES.



TYPICAL OPEN KETTLE PROCESSES USING PROGRAM CONTROL OF TIMED HEATING CYCLE AND KETTLE DISCHARGE (LEFT) AND CAM PROGRAM CONTROL OF TWO SEPARATE PROCESS VESSELS WITH A SINGLE INSTRUMENT (RIGHT).

Heat radiated from the surface of an object bears a definite relationship to the temperature of that object; this principle is employed in the radiation pyrometer. Heat rays are focused by a lens on a thermopile, a group of tiny thermocouples electrically connected in series. Voltage developed by the thermopile is evaluated in terms of temperature by means of a millivoltmeter or electronic potentiometer. Designs of radiation measuring elements are available to cover temperatures from ambient to 3200 F. One model can measure the temperature of objects as small at  $\frac{1}{4}$ -inch having temperatures as high as 7000 F; they can measure 98 per cent of a temperature change in two seconds.

For a number of industrial temperature measuring problems, the radiation pyrometer offers the following advantages over other means of measurement as a basis for temperature control:

- It permits measurement of temperatures far beyond the limits of other common means.
- It offers most practical method of measuring the surface temperature of objects within a furnace or other equipment as well as of moving objects on mills or other machinery.
- It avoids subjecting the measuring element to atmospheres detrimental to elements.

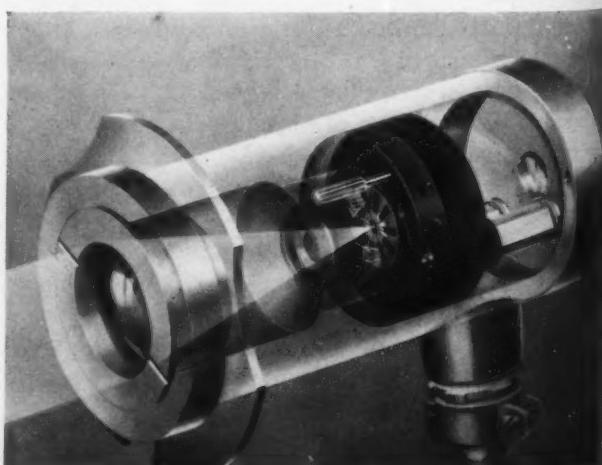
#### Control in Open Vessels

Heating in open kettles, tanks, and vats is widely used in industry for operations such as melting, blending, and concentrating, or for accelerating reactions. The temperature control may take the following forms: maintenance of temperature at a predetermined value for a predetermined length of time; heating the contents to a certain temperature and then shutting off or automatically discharging the vessel; heating the contents up to a temperature at a predetermined rate; or removing heat resulting from exothermic reactions.

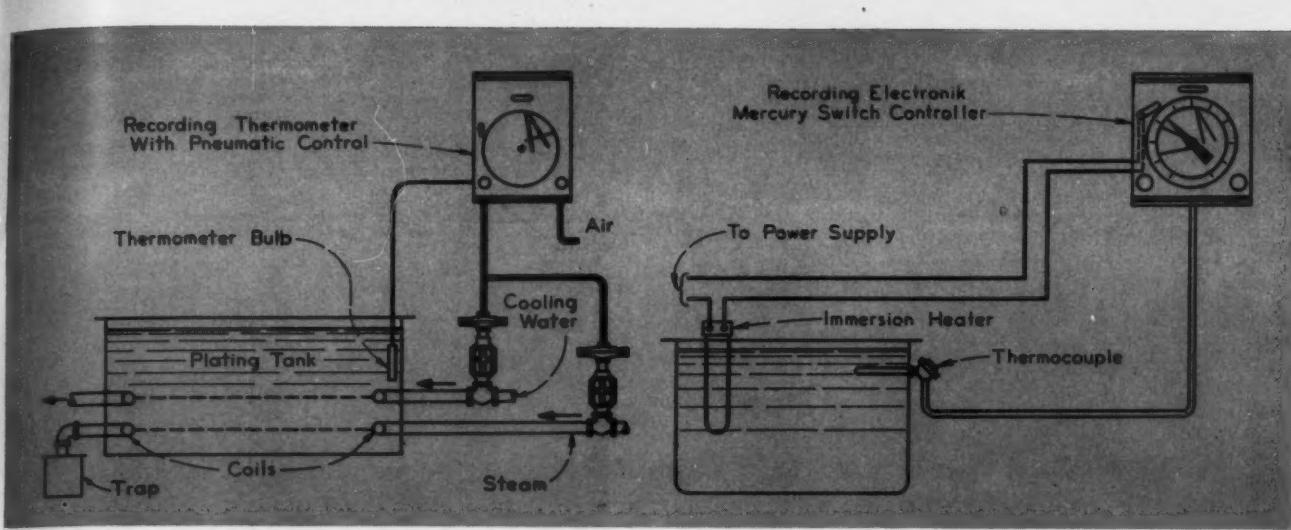
In the application of automatic temperature control equipment to such operations, consideration must be given to the heating medium and the manner in which it is to be applied to the vessel; to the size, shape, and material of which the vessel is made, as well as agitation, piping, and method of loading and unloading; to the functional purpose of the automatic control equipment; and to the closeness of system regulation desired.

#### Control in Closed Vessels

In most liquid-heating operations in closed vessels such as in fractionating columns, the space in the vessel above the liquid phase is filled with vapor. Vapor pressure is an indirect measure of temperature, and pressure controllers may be used in place of temperature controllers. They have the advantage of lower cost, are simpler to install, and should give closer control because there is less lag.



PHANTOM VIEW OF RADIATION PYROMETER SHOWING HEAT RADIATION FOCUSED ON THE SENSING ELEMENTS.



IN THESE TEMPERATURE-CONTROLLED SYSTEMS, HEATING AND COOLING OF A VESSEL (LEFT) AND ENERGIZING OF AN ELECTRIC IMMERSION HEATER ARE PROCESSES OPERATED IN RESPONSE TO VESSEL TEMPERATURE.

Pressure control in lieu of temperature control, however, may be unsatisfactory for processes requiring the introduction of inert or other gases. If direct temperature control is required, the presence of inert gases or other factors make a pressure-recording pen a useful adjunct. Conversely, when pressure is controlled, an auxiliary temperature record on the same chart can be of value.

#### Limit Control

Often in an industrial temperature control system, excess temperature may be particularly critical, possibly endangering expensive process equipment, material being processed, and plant personnel. In such cases it is considered well worth the investment to add a second control instrument with a separate measuring system for shutting down the process in the event of excess temperature. Such a controller may be a simple non-indicating controller or an indicating type of millivoltmeter controller which, for example, can be arranged to sound an alarm or close a valve on a fuel line.

In certain applications the limit controller may be arranged to close the control valve normally operated by the temperature controller, but the system must be designed so that the valve will close in case of power failure to be absolutely "fail-safe." Frequently electric, pneumatic, or electric-pneumatic relays are incorporated in the control system to carry out the control action.

#### Program Control

Temperature is often the controlling factor in the programming of industrial processes. In a typical open vessel operation, the contents may be brought up to a pre-determined temperature, held there for a given time, and then discharged at the same time that the heat is shut off. Pressure switches are arranged to start timers for the cooking interval

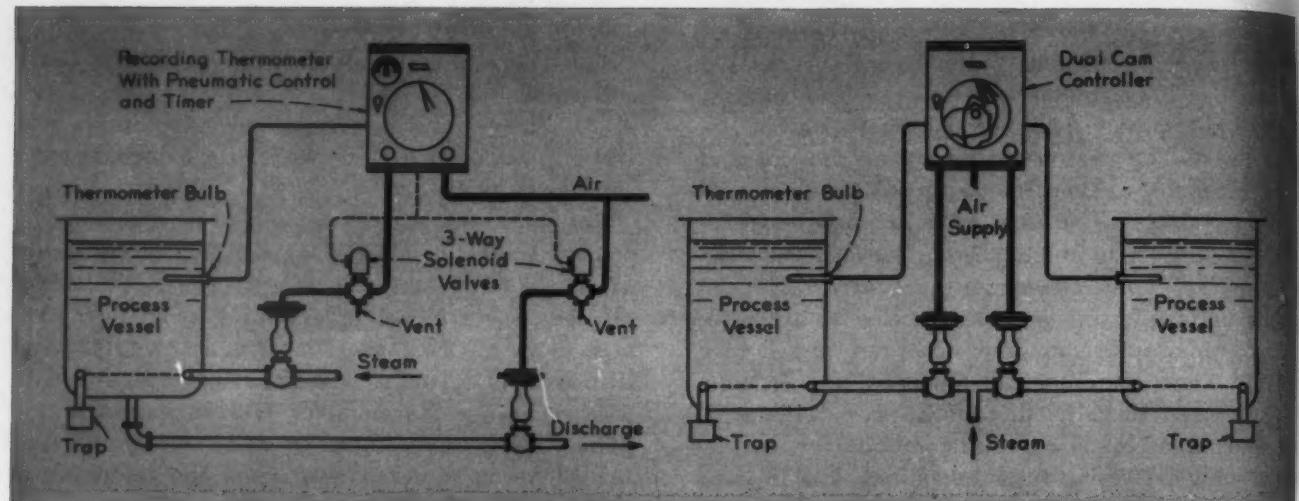
when the charge reaches process temperature. During cooking, the temperature control maintains the proper heat and turns it off when the cooking time is over. When the vessel is to be re-loaded, the operator pushes a button to reset the timers and valves while the vessel cools so that the temperature control cycle reverts to initial conditions.

Another system makes use of a cam programmer thermometer which measures, records, and controls temperatures in two process vessels. The two cams in the instrument can be driven separately at the same or different speeds to conform with the programming requirements. The instrument responds to the individual time-temperature pattern of each cam so that additional programming variations can be accommodated.

In exothermic reactions, it is often necessary to remove the heat generated in the vessel to maintain the proper temperature. In chromium plating, for example, the bath may contain heating and cooling coils whose valves are pneumatically operated from the temperature control instrument.

Temperature control of electrically heated processes is generally of the on-off type. When the temperature is high, the power supply circuit is opened, and when the temperature is low the power supply circuit is closed. Other power controls for electrical heating may use adjustable resistors, input controllers, multi-tap transformers, and induction regulators driven by reversible motors. The motors are in turn operated through the use of a mercury switch actuated by the temperature control instrument.

Recent trends toward the use of infrared heating pose a problem in that the object being heated becomes hotter than its immediately surrounding environment. Extreme care must be taken to place the temperature sensing device where a reliable indication of the critical temperature can be made.



TYPICAL OPEN KETTLE PROCESSES USING PROGRAM CONTROL OF TIMED HEATING CYCLE AND KETTLE DISCHARGE (LEFT) AND CAM PROGRAM CONTROL OF TWO SEPARATE PROCESS VESSELS WITH A SINGLE INSTRUMENT (RIGHT).

Heat radiated from the surface of an object bears a definite relationship to the temperature of that object; this principle is employed in the radiation pyrometer. Heat rays are focused by a lens on a thermopile, a group of tiny thermocouples electrically connected in series. Voltage developed by the thermopile is evaluated in terms of temperature by means of a millivoltmeter or electronic potentiometer. Designs of radiation measuring elements are available to cover temperatures from ambient to 3200 F. One model can measure the temperature of objects as small at  $\frac{1}{4}$ -inch having temperatures as high as 7000 F; they can measure 98 per cent of a temperature change in two seconds.

For a number of industrial temperature measuring problems, the radiation pyrometer offers the following advantages over other means of measurement as a basis for temperature control:

- It permits measurement of temperatures far beyond the limits of other common means.
- It offers most practical method of measuring the surface temperature of objects within a furnace or other equipment as well as of moving objects on mills or other machinery.
- It avoids subjecting the measuring element to atmospheres detrimental to elements.

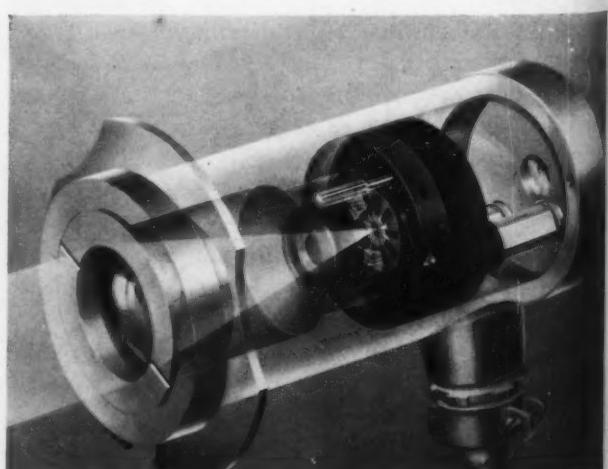
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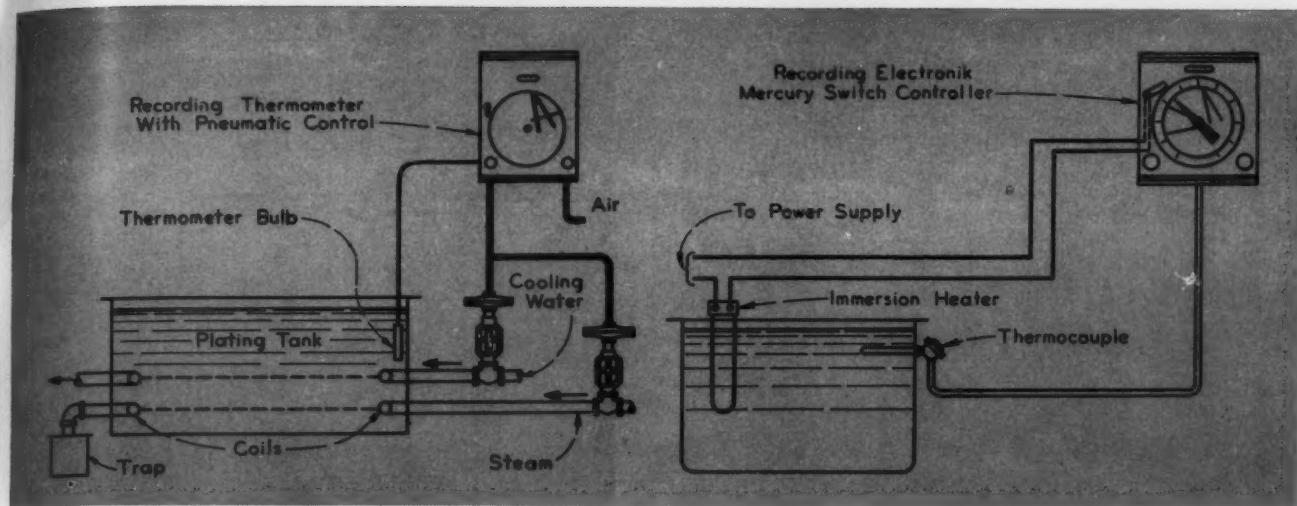
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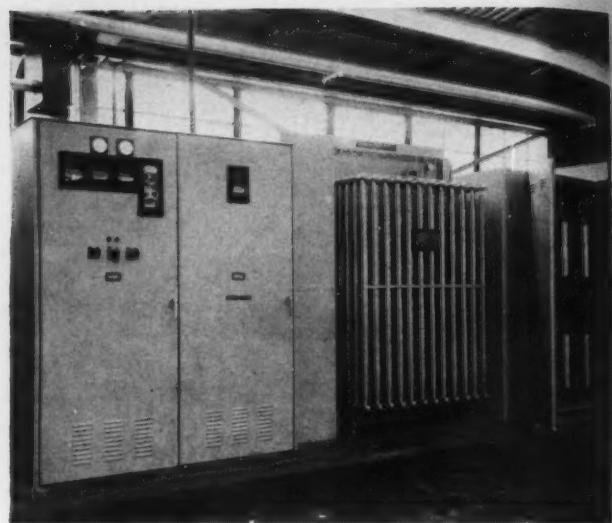
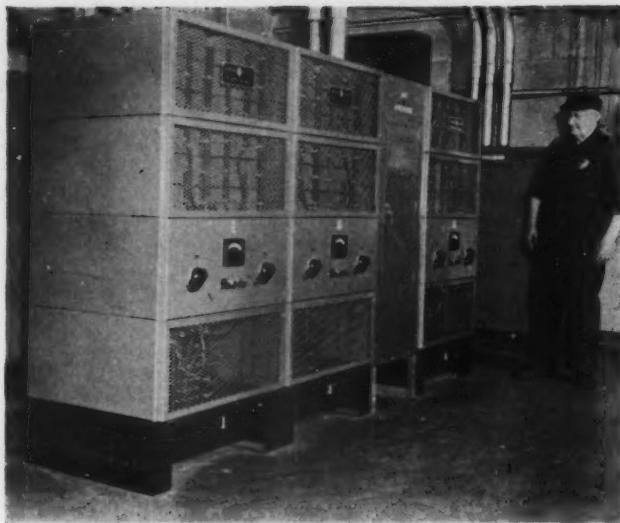
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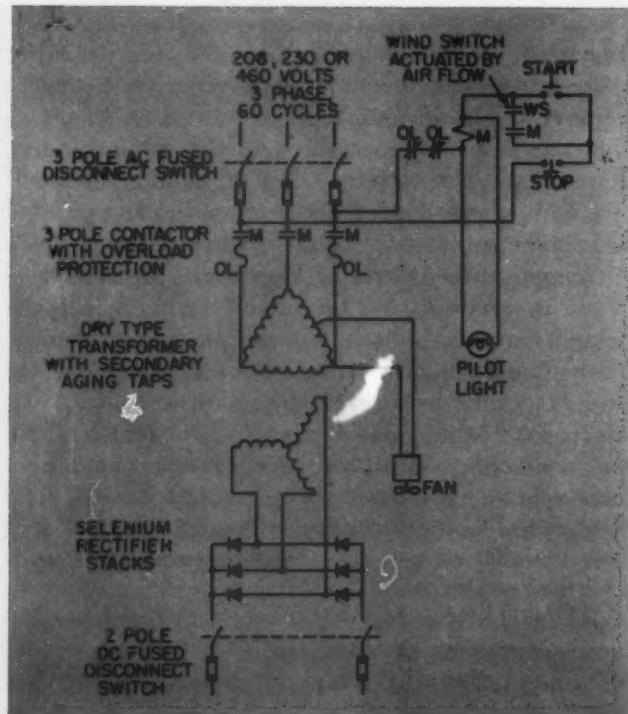
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A TYPICAL INSTALLATION OF SELENIUM RECTIFIERS OPERATING IN A LARGE BUILDING OF A MAJOR CITY (LEFT) AND A D-C UNIT SUBSTATION WHICH UTILIZES MERCURY ARC RECTIFIERS FOR CONVERSION (RIGHT).

# Shall It Be Selenium or Mercury Arc Rectifiers

C. E. HAMANN  
Lighting and Rectifier Dept.  
General Electric Company



ELEMENTARY SCHEMATIC DIAGRAM OF A TYPICAL  
SELENIUM RECTIFIER AND ITS ASSOCIATED CIRCUITRY.

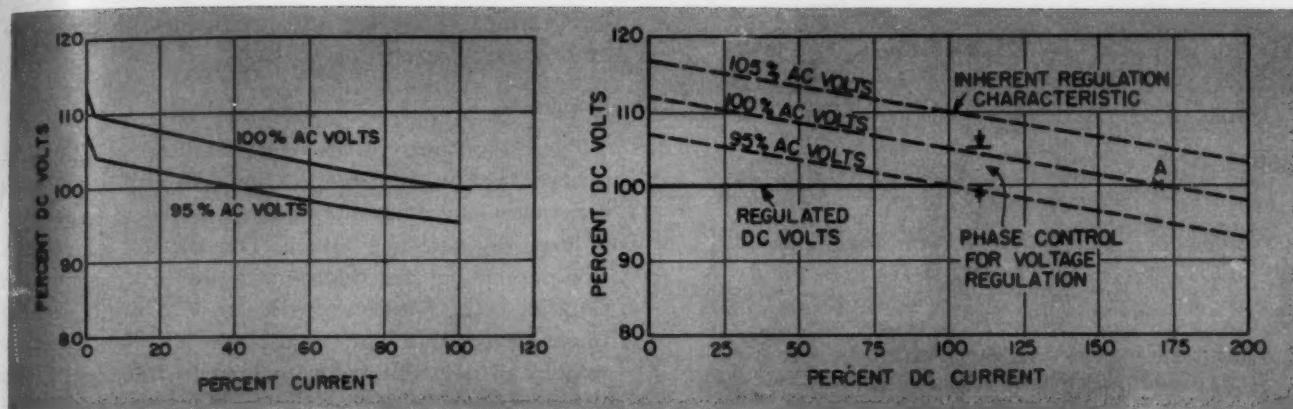
THE MODERN TREND in industry is toward the use of rectifiers for 250 v, d-c constant voltage power supplies. Many inherent advantages such as reduced maintenance, low operating costs, and ease of installation have undoubtedly been contributing factors to the trend.

Two markedly different types of rectifier units have become widely accepted for such applications. Selenium rectifiers and mercury arc rectifiers each convert a-c power to d-c power, without rotating parts, but their similarity stops here.

In general, rectification by selenium is available in a range from milliwatt power levels to perhaps 300 kw. On the other hand, mercury arc rectifiers are considered economical over a range of 75 kw to many thousands of kw.

Thus, it is evident that while the application of these two types lies mainly in different fields, there is an overlapping in the range of 75 to 300 kw at 250 v, d-c. The relative merits of each type must be carefully weighed before deciding on the type to use for a particular application.

It must be kept in mind that application experience involving power requirements in this range has been more extensive with mercury arc rectifiers



CHARACTERISTICS OF UNREGULATED SELENIUM RECTIFIER UNIT (LEFT) AND OF MERCURY ARC RECTIFIER UNIT (RIGHT). AT 100 PER CENT A-C SUPPLY, REGULATED D-C OUTPUT IS EXTENDED TO POINT A (RIGHT).

than with selenium. However, the use of selenium is increasing rapidly and statistical data are being accumulated with time and experience.

#### Design

The selenium rectifier, in common with all other metallic rectifiers, allows free passage of current in the forward direction but negligible current in the reverse direction. The basic unit consists of an insulated-type transformer and the selenium rectifier stacks. In a typical installation, a dry-type transformer suitable for 3 phase, 60 cycle operation on 208, 230, or 460 volts is used. The primary is delta-connected; the secondary winding is wye-connected and supplies the required a-c power to the stacks to obtain rated d-c voltage at rated load. Transformer taps provide compensation for changes in forward resistance of the rectifier cells due to aging as well as for 10 per cent variation in supply voltage.

The 3 phase, full-wave bridge type circuit gives a 6 phase d-c output voltage with an inherent ripple of about 4½ per cent. When the application requires it, equipment may be added to perform such functions as d-c voltage regulation and dynamic braking protection.

The mercury arc rectifier unit also allows free passage of current in one direction, and for all practical purposes, none in the opposite direction. Sealed mercury arc ignitron tubes convert a-c power to d-c electronically. A rectifier unit consists essentially of the transformer and rectifier with rectifier control sections.

#### Ratings

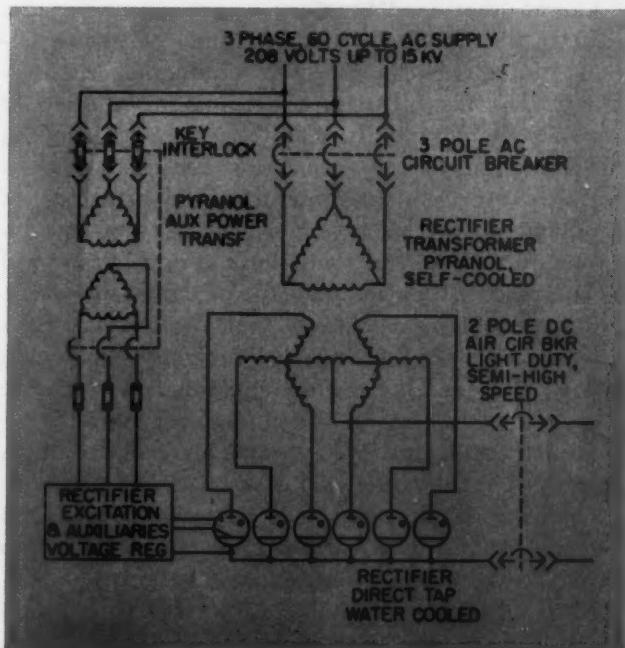
It is common practice in the metallic rectifier industry to rate selenium rectifiers on a continuous basis only, corresponding to what appears on the nameplate. The unit has no overload rating as such primarily because of the inherently low thermal capacity of the selenium rectifier cells. This is easily understood when one considers the relatively small mass of metal in a selenium stack assembly. Con-

servative design permits occasional overloads of 125 per cent rated current without injury. All ratings are based on a maximum ambient temperature of 35 C (95 F).

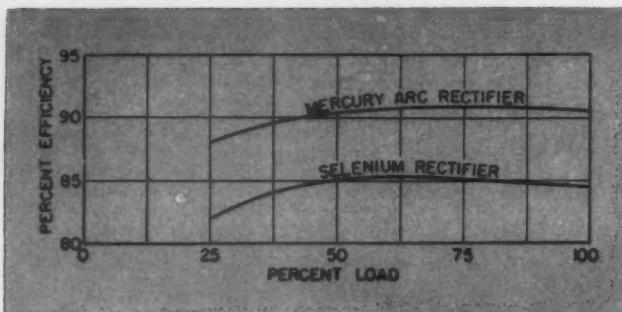
The mercury arc rectifier unit has both a continuous and an overload rating. The units illustrated have a rating which applies to industrial service, which is: 100 per cent rated continuous load; 125 per cent current for 2 hours following 100 per cent load; and 200 per cent current for 1 minute following 100 per cent load.

#### Overloads

At any time that the full load temperature rise is not exceeded, the rectifier unit is capable of operating at the overloads. The limiting component is usually the rectifier transformer. It is rated 60



SCHEMATIC DIAGRAM OF TYPICAL SEALED IGNITRON MERCURY ARC RECTIFIER UNIT AND ITS AUXILIARIES.



EFFICIENCIES OF COMPARABLE SELENIUM AND MERCURY ARC RECTIFIERS UNDER SIMILAR LOADING.

C rise at the two-hour overload of the rectifier unit, following operation at rated load until the temperature rise is constant.

Industrial loads usually have peak and average demands which may be supplied by a rectifier with both a continuous and a short time overload rating. Because of the lack of such overload ratings, it usually develops that more total capacity in selenium rectifiers is required to do the same job than would be required for a mercury arc rectifier unit with a continuous rating equal to the average load demand.

#### Flexibility

Selenium rectifiers are usually limited to installations where the total power requirements are 300 kw and below. For higher ratings, the large number of units which must be connected in parallel not only adds to the installation costs but requires more floor space than a comparable capacity in mercury arc rectifier units.

On the other hand, the d-c power requirements in a modern plant may frequently change with production equipment changes and production requirements. The flexibility of a multiple installation of smaller selenium units readily permits regrouping or relocation to meet changing requirements. A further advantage resulting from the flexibility in grouping smaller units, is the possibility of spot location of d-c power at the point where it is required as compared with a complete d-c distribution system.

It must be remembered that these advantages usually apply only where the a-c supply is 480 v and below. The cost of added equipment to operate from other a-c voltages should be considered.

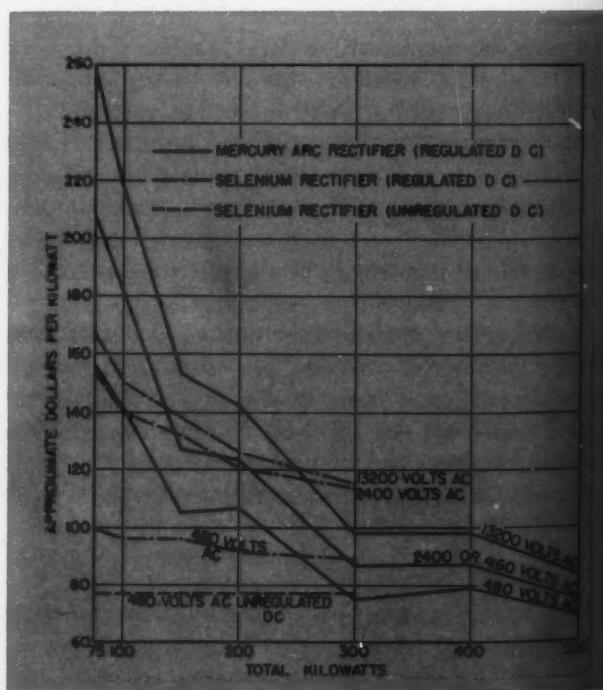
By paralleling several mercury arc rectifier units, there is virtually no practical limit to the amount of power which can be economically supplied. Several of the larger units may be paralleled to provide total power requirements of about 1000 kw. Above 1000 kw, the number of paralleled units becomes large, and fault currents usually require a different class of switchgear. However, pumpless and pumped mercury arc rectifiers beginning with

unit ratings of 750 kw and provided with adequate switchgear may be used.

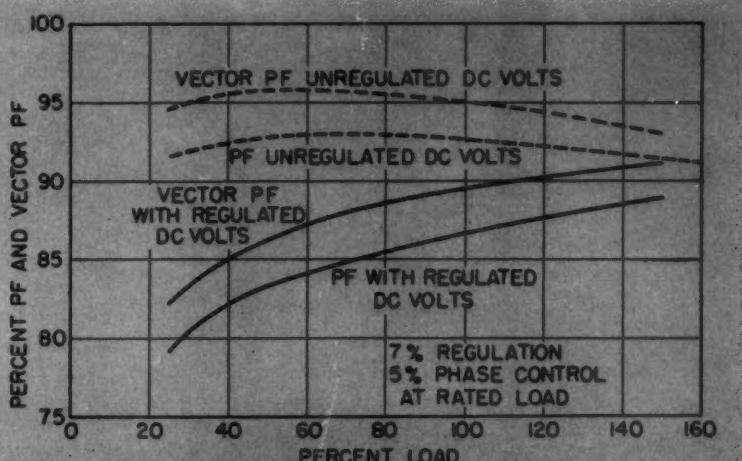
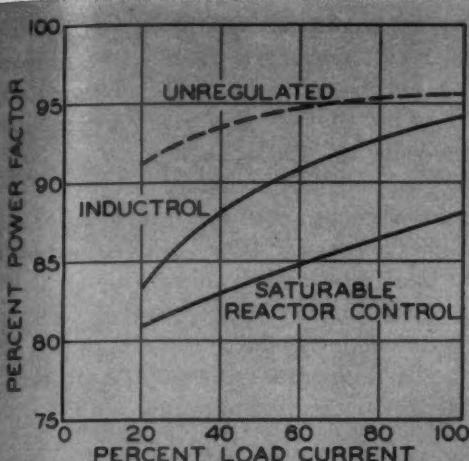
#### Regulation

The d-c output voltage of a selenium rectifier unit droops inherently from no load to full load with constant a-c voltage applied, unless some means of voltage regulation is added. The amount of regulation depends on the degree of aging of the selenium rectifier cells. However, as a rule of thumb, it may be assumed that the regulation will be approximately 13 per cent from no load to full load when the stacks are fully aged. When new, the regulation will be somewhat better than this. It should be noted that a substantial part of the inherent regulation occurs in the first 25 per cent of load. From  $\frac{1}{4}$  to full load, the regulation is in the order of 7 to 8 per cent.

Any changes in a-c system voltage are directly reflected into the d-c output voltage of unregulated rectifiers. When the normal regulation of a selenium rectifier cannot be tolerated, additional equipment may be obtained to regulate the d-c output voltage. By supplying one or more selenium rectifier units from an induction voltage regulator designed for 10 per cent buck or boost, a reasonably good regulated d-c output may be obtained. It should be recognized that this type of regulator has a slow speed of response inherent with a mechanical system. However, for many applications its grade of performance



COST OF COMPARABLE CAPACITY IN SELENIUM RECTIFIERS AND MERCURY ARC RECTIFIERS. DATA ABOVE INCLUDE UNIT SUBSTATION INTERCONNECTIONS FOR MERCURY ARC UNIT; INTERCONNECTION COSTS WITHIN SELENIUM RECTIFIER NOT INCLUDED.



TYPICAL POWER FACTOR CHARACTERISTICS FOR SELENIUM RECTIFIER UNIT (LEFT) AND FOR MERCURY ARC RECTIFIER UNIT (RIGHT). IN BOTH RECTIFIERS, REGULATORS ACT TO REDUCE THE INHERENT POWER FACTOR.

ance may be considered entirely satisfactory.

Where faster response is required, saturable reactors in the incoming a-c lines do a good job. By controlling the saturation in response to output voltage, high speed of response may be obtained with a good regulating accuracy. The size of the reactors depends upon the degree of accuracy required.

All known methods of voltage control for metallic rectifiers function by means of adjusting the voltage ahead of the rectifier. Phase control is not employed, and each rectifier element provides full conduction, thus eliminating some power factor problems.

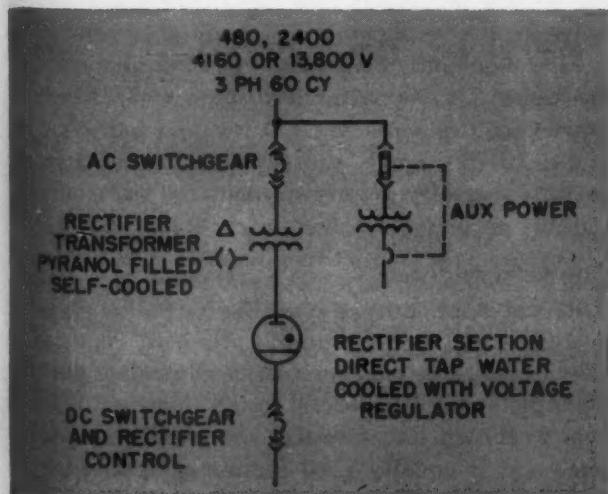
Voltage control of mercury arc rectifier units may include an amplitstat voltage regulator which continuously and automatically regulates the d-c output voltage for changes in load and a-c system

voltage by adjustment of the firing angle, or phase control.

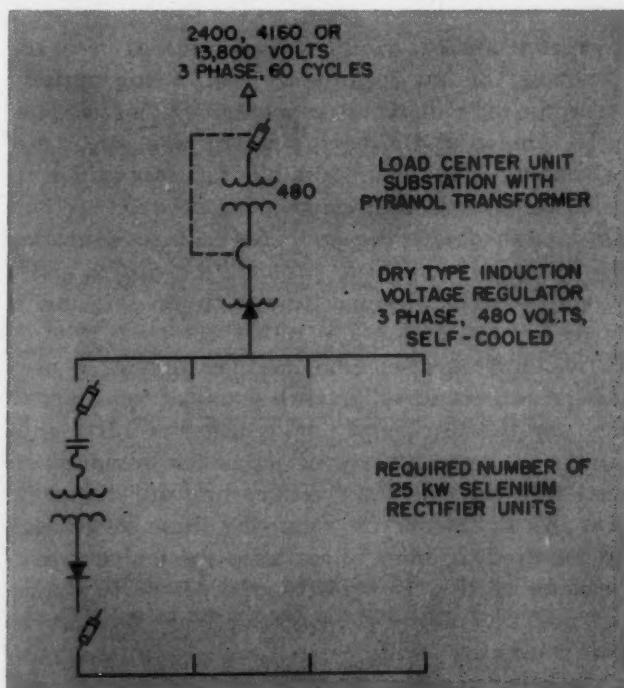
#### Power Factor

Rectifiers have a lagging power factor. One of the influencing factors is the amount of phase control used for voltage regulation with mercury arc units.

The selenium rectifier unit is not phase controlled. Since its unit rating is generally small compared to the a-c system to which it is connected, its vector power factor is predominantly affected by internal characteristics. As a general rule of thumb, a vector power factor of 90 to 95 per cent lagging may be considered typical over the operating range for an



CIRCUITRY OF MERCURY ARC RECTIFIER (ABOVE) AND SELENIUM RECTIFIER (RIGHT) USED FOR COST COMPARISON GRAPH ON PRECEDING PAGE.



unregulated unit. When regulated d-c output voltage is furnished with selenium rectifier units, the power factor is reduced by added reactance.

#### Efficiency and Losses

Both types of rectifier units have a fairly constant efficiency from  $\frac{1}{4}$  to rated load; each has relatively low no-load losses, an important consideration in d-c distribution systems where the load is variable and full-load capacity may be required at only infrequent intervals.

The no-load losses of the selenium rectifier unit consist primarily of the transformer magnetizing and cooling fan losses. For the mercury arc unit, these losses consist of transformer magnetizing and excitation equipment losses. Values of 750 watts for the 25 kw selenium and 4.1 kw for the 300 kw mercury arc rectifier units are typical.

#### Maintenance

Having almost a complete absence of moving parts, both types of rectifier units naturally require little maintenance. The principal component of the mercury arc rectifier unit likely to require renewal is the sealed ignitron tube. Tube life records indicate that the expected average tube life is now at least six years. Tube replacement is about a 15 minute job.

The rectifier stacks are the only components likely to require replacement over the life of the selenium rectifier unit. While field data is not too complete, the results of controlled tests indicate a stack life expectancy of at least ten years. The contingency of stack failures is usually provided for by keeping spare elements which may be used to replace defective ones.

#### Installation

The mercury arc rectifier unit when furnished as a complete a-c to d-c unit substation is ideal from the standpoint of low installation cost. Being entirely static, the individual metal enclosed sections need only be skidded into place and bolted together on any reasonably level floor suitable for supporting its dead weight. All inter-connections between sections are furnished with the equipment. After connecting the incoming a-c cables, outgoing d-c cables, and a supply of cooling water for the tubes, the unit is ready for operation.

The individual selenium rectifier unit is, if anything, even easier to install because of its compactness and the absence of cooling water requirements. Unlike the mercury arc unit, all of the losses associated with the selenium rectifier unit are dissipated into the air. Means for removing these losses may be required in order to maintain the ambient temperature at 35 C or below for proper performance.

Since several selenium rectifier units must be paralleled, the additional a-c and d-c interconnections between units which must be furnished and

installed by the customer should be considered in comparing installation costs. While the interconnections of a number of 25-kw units offers some disadvantages in installation, this may be outweighed by the flexibility of the system permitting quick changes in grouping and location.

Both types of rectifier units require special consideration where a regenerative load is being served, since they are inherently unidirectional current devices. A dynamic braking protective panel and loading resistor may be added at an increased price to either the basic selenium or mercury arc rectifier unit for absorbing the regeneration.

#### Faults

Certain applications require a high degree of reliability in the d-c power supply. Continuity of d-c service is usually required as long as a-c power is available, and in spite of occasional internal faults in the conversion equipment.

The most common internal fault likely to occur in the mercury arc rectifier unit is the arc back. During arc back, fault currents flow internally from the other rectifying elements of the rectifier to the faulty ones and externally from parallel rectifiers, rotating d-c machines, and other sources of counter-emf connected to the bus. Breaker tripping characteristics may be selected to remove only the faulty unit, with the normal unit remaining on the bus to supply the load.

The selenium rectifier unit may develop an internal fault due to short circuit. The characteristics of the a-c and d-c fuses furnished with each unit may be chosen to remove only the faulty unit, permitting the remaining units to carry the load.

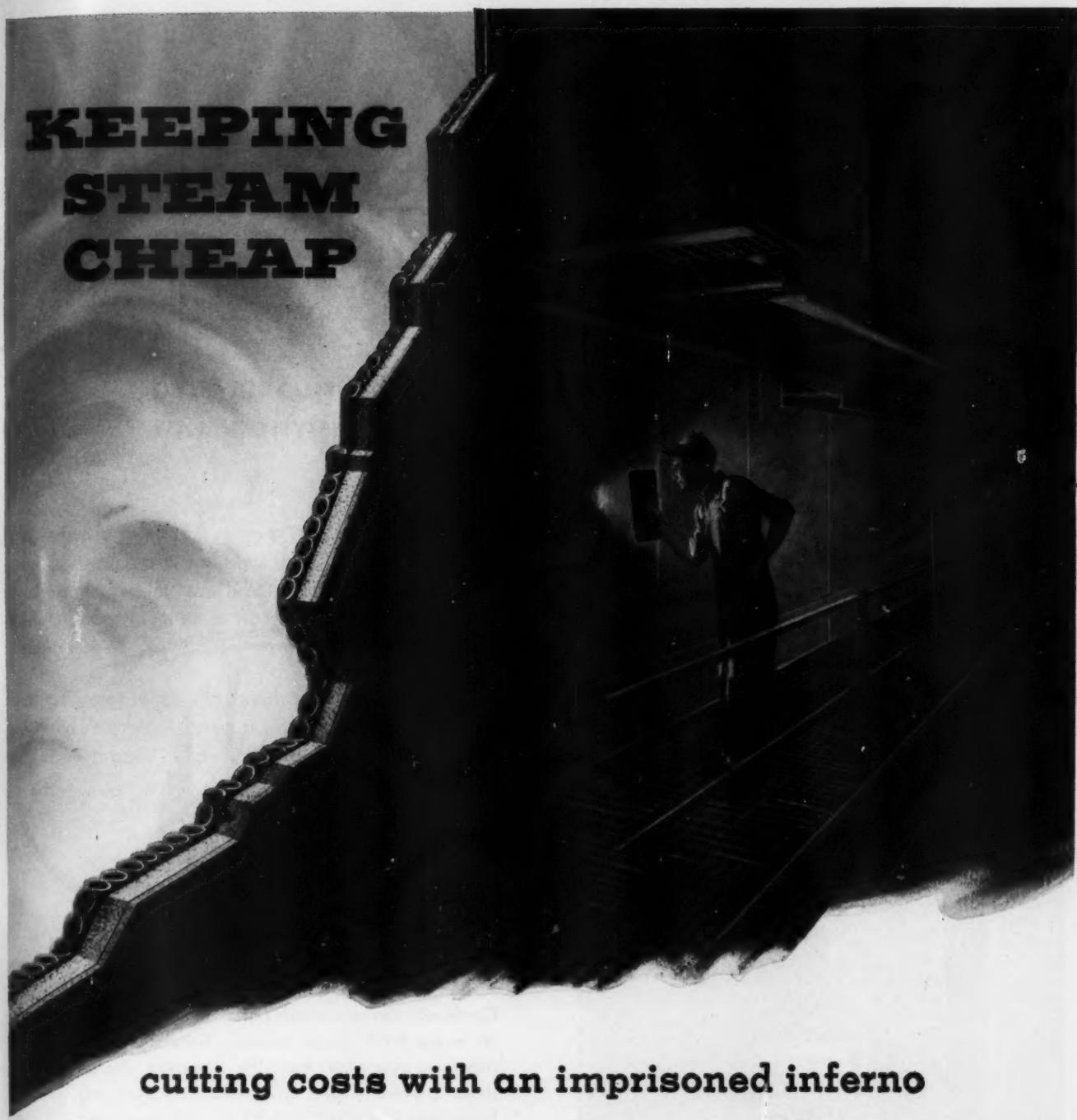
If faults in the distribution system common to all rectifiers are likely, then suitable distribution feeder breakers may be furnished for each type of equipment to provide selective operation between the source protectors and the distribution system.

When the application is essential service, economics alone may favor one type of equipment over the other. This is particularly true where the total power requirements are 150 kw and below at 250 v d-c. In this range, the cost of two mercury arc rectifiers usually greatly exceeds the price of comparable capacity in selenium rectifier units.

#### Cost Considerations

Recent price lists are available for the two types of rectifiers for the minimum equipment required to offer comparable functions. Price alone does not offer a simple answer, however, to the question of which type to choose. Each rectifier has found wide acceptance and is equally good for many applications in the range from 75 to 300 kw at 250 volts dc. Special considerations and conditions of the specific application must be analyzed carefully before making the final choice.

# KEEPING STEAM CHEAP



## cutting costs with an imprisoned inferno

When giant, coal-hungry boilers are fed as much as 50 to 100 tons of coal per hour, B&W's fuel savings through use of pressurized furnaces finds major importance in *keeping steam cheap*.

Power engineers had known for years that worthwhile savings in construction, operation and maintenance costs could be achieved if they found a good way to make boiler furnaces tight enough to operate under pressure. But with modern furnaces 10 to 15 stories high, containing a raging inferno of gases with temperatures up to 3600 degrees, the solution was not easy to find. Intensive engineering investigation plus a thorough knowledge of operating problems

and conditions was needed before a successful pressurized furnace could be built. B&W engineers have licked this problem and today pressure fired boilers are serving in many of the country's greatest power stations. Already, 24 units are in successful operation—the first of them with over five years experience—and an additional 68 to serve over 7,000,000 kw of generating capacity are on order.

Pressure-firing often is used in combination with other major advances in modern steam generation resulting from B&W's Research and Development program. These include high pressures and temperatures, divided furnaces, cyclone steam separator, and Cyclone Furnace firing.

**BABCOCK  
& WILCOX**

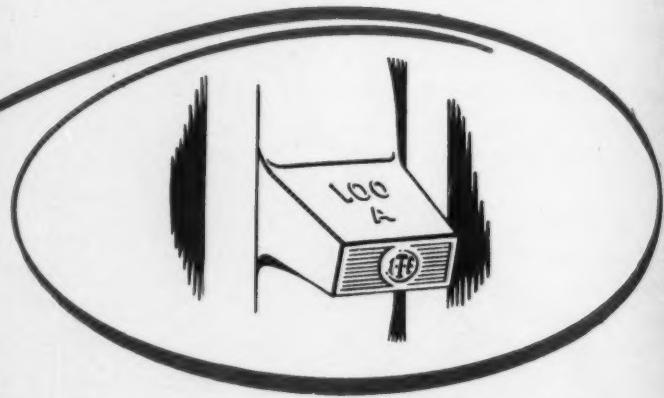


BOILER DIVISION

N-151

51

**Compare the**



Continuous current rating is permanently engraved on every I-T-E Circuit Breaker. Here's straightforward assurance that the complete device (both protective and disconnect features) has been tested as a unit under load and approved for the rating specified.



**INDIVIDUALLY-ENCLOSED**

# current ratings before selecting electrical protective devices

**I-T-E CIRCUIT BREAKERS WILL SAFELY CARRY THEIR  
FULL CONTINUOUS CURRENT RATING INDEFINITELY**

**First, bear in mind** that every I-T-E Circuit Breaker is tested and rated as a complete unit. The rating prominently engraved on the breaker is the true current rating of a protective device, as well as a disconnect device.

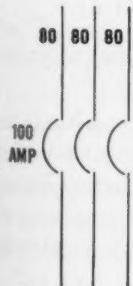
**Then consider** that an enclosed fusible switch is tested and rated as a *switch alone*. If tested as a unit complete with conventional fuses, it would not safely carry its

full-rated current continuously. The heat generated before the fuse would blow could be terrific; the switch portion might not stand it.

**That's why** The National Electrical Manufacturers Association recommend that "fused switches should be selected so as to have a rating at least 50 percent in excess of the load, for continuous duty."

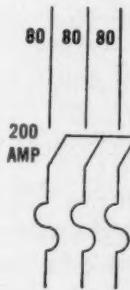
Circuit breakers, however, are taken at "face value."

**For example**—Suppose you have the problem of providing circuit protection for a feeder supplying a continuous-load lighting panelboard. It happens you have 80 amperes traveling over each wire of a 3-phase feeder system. Selected wire size is rated 100 amperes. (The National Electrical Code says wires cannot be loaded continuously to greater than 80% for safety.)



## CIRCUIT BREAKERS

for this job are selected simply. *Just match the circuit breaker rating to the wire size!* Install an enclosed 100-ampere 3-pole I-T-E circuit breaker for complete protection and safety.



## ENCLOSED FUSIBLE SWITCHES

for this job (according to NEMA) should be rated at least 50% in excess of the 80-ampere load. This means a 120 ampere current rating. In this case, it would be necessary to apply the next higher standard size—a 200-ampere switch!

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# CIRCUIT BREAKERS



# Dr. Palyi's Page

Each month on these pages Dr. Melchior Payli, Consulting Economist, answers readers' questions on economics and finance. Address mail to: Editor, CONSULTING ENGINEER, St. Joseph, Michigan.

- Public Utilities — Private or Government
- Western Europe — Nationalization or Free Economy

*Drawing upon your broad background and intimate knowledge of European affairs, would you discuss some of the factors that have influenced the post-war economic and industrial recovery in Western Europe?*

DR. PALYI: Speaking of industrial recovery in Europe we must clearly define what we mean. If we mean in terms of full-employment, production indices 30-50 per cent above pre-war levels in physical as well as in dollar terms, then, of course, there has been a tremendous recovery. But, if we mean recovery in the sense of placing the economies on a sound operating basis, that's another question!

*Would you amplify this last statement?*

DR. PALYI: There are many factors at play. In England, France, and Italy a great deal of nationalization has taken place. Even in the non-nationalized sector of the industrial set-up, governmental influence, intervention, and management—direct and indirect—are very widespread. That also includes countries like Sweden and Norway and, to some extent, Holland.

It is interesting to note that the countries which recover most rapidly and make the greatest progress are the ones which have not nationalized industries and indulge in comparatively less government intervention. I am referring especially to Belgium and Germany.

*Has the question of public vs. private power been resolved in Belgium and Germany, the countries you mentioned as having a minimum of intervention, as compared with England?*

DR. PALYI: In England all utilities are nationalized. In France they are nationalized. In Italy most of them are nationalized. In Belgium and Germany, the

prevailing system of financing is a combined ownership by municipalities and private interest. The mayor of the town is often the chairman of the board, while in Germany particularly, the manager of the corporation is chosen by the private interests. There are some cases of wholly government-owned public utilities and some completely privately owned. But nowhere, in Belgium or Germany, does the central government participate to any appreciable extent.

*To what extent does industrial power depend on coal?*

DR. PALYI: Approximately 75 per cent of Western European power depends on coal. It must be remembered that coal is by far the principal fuel of Europe, much more so than in this country. And that holds to an even greater extent for household fuel.

*Who is responsible for the regulation of utility rates?*

DR. PALYI: Where the utilities are nationalized, the rates are set by a special organ—a public corporation which usually proceeds by charging the consumer whatever the traffic can bear, or sometimes even more than the traffic can bear! It simply operates on the cost-plus basis.

The classic example is British coal (which is considered a utility in Britain) the price of which is now more than three times what it was in pre-war days—far ahead of practically all other commodity prices. This has been due to the exorbitant rise, comparatively speaking, of coal miners' wages, coupled with reduced productivity.

In the non-nationalized segments of the European economy, the techniques of setting utility rates follow no definite pattern. The utility rates are regulated locally by understandings between the municipi-

pality and the private interest. There is no science of public utility rate regulations as in America. And as far as the European courts are concerned, they are seldom, if at all, concerned with these questions. In Germany the matter is, as a rule, handled informally between the mayor or the city council and the utility's board of directors.

*Are there comparisons of the profits shown by nationalized utilities with those operating in a more liberal economy?*

DR. PALYI: That is not possible because of the many differences between the various countries. Then too, it is very difficult to read and correctly interpret the balance sheets of the nationalized industries. It is a fact, however, that many utilities in England—and practically all of them in Italy and France—are running at a loss. Whether the fault lies with the operators or whether it is political intervention is hard to determine.

On the whole, the nationalized utilities, including the railroads, answer to two masters, in a manner of speaking. For one thing, it is politically expedient not to charge too much—better to take the loss and have the government carry it in the budget. On the other hand, there is an opposing pressure to minimize losses at the expense of the consumer in the form of higher rates. So you have the two alternatives. Either the consumer pays too much or the tax-payer has to carry the deficit. There are very few examples of nationalized utilities which have operated at a profit without greatly exceeding the average price level in their charges. In fact, the nationalized post, telegraph, and telephone utility is the conspicuous example in most countries.

*What are the principal elements responsible for the pressure that has brought about nationalization?*

DR. PALYI: In the first place, the pressure of the coal miners in England—to a lesser extent also in France. They were very dissatisfied, putting it mildly, especially the British, due to the long depression which began in the middle twenties and lasted until World War II. They were rebelling against the existing system, and as an alternative they chose nationalization.

But that wouldn't have been the decisive factor if it had not been for the general climate of Europe after the war. The climate was definitely socialistic; opposed to the automatic operation of the market; opposed to the profit motive. The profit motive was to be discarded, especially in basic industries, in favor of public group ownership or nationalization.

*Has the factor of technological improvement entered the picture?*

DR. PALYI: There are two things to be considered. One is natural conditions. The geological conditions

under which coal is mined in Europe are far more unfavorable than in America. Most mines are very deep and many difficulties are encountered. Still, that was partly overcome by mechanization. It must be remembered, however, that mechanization has its limits, and in deep and narrow shafts mechanized operations are impractical.

In Britain, new equipment to the tune of half a billion dollars has been invested in the mines since the last war. In France, the figure has exceeded seven-hundred million. It is remarkable that in spite of this mechanization, and while French output per man-shift under even worse conditions has risen some 15 per cent over the pre-war level, British production is just about where it was before the war and well below where it stood some twenty years ago.

*The root of this problem of nationalization in Europe seems to lie with the coal miner?*

DR. PALYI: The human factor is the decisive one, no two ways about it! Of course, new equipment helped; otherwise the entire situation might have been catastrophic. But why, for example, should there be a slight decline in man-shift output from 1951-52—a very slight decline but nonetheless a decline. Why is absenteeism still almost 12 per cent per shift on the average? You cannot explain these things without realizing the spirit that prevails in the labor movement of Britain today, especially in the nationalized industries—coal, the leader among them.

*Has the coal industry in this country resisted technological mechanization and improvement as much as in Europe?*

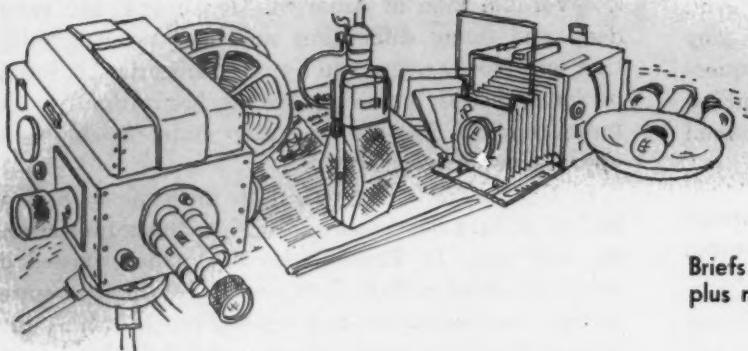
DR. PALYI: When we speak of Europe, we should emphasize Britain; because the Germans and French have not resisted mechanization in the coal mines—not seriously . . . nor are the Belgians opposed to the introduction of new equipment.

American labor distinguished itself by its willingness to accept and promote technological developments. While British labor, with notable exceptions, is suspicious of technological progress, afraid that it may mean over-production and unemployment.

*Perhaps the American engineer has played a larger role than his counterpart in Europe in selling technology?*

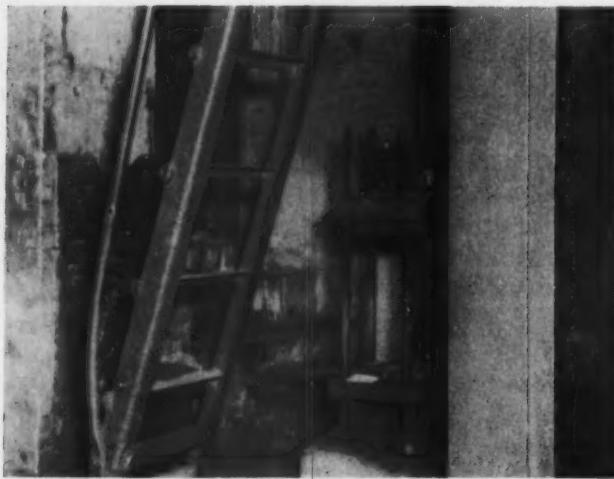
DR. PALYI: In Europe, the engineer is, by and large, a technical adjunct to production. The prime interest is the protection of vested interests and of existing stratifications. It is particularly true of Britain, France, and Italy; less so in Belgium and Germany.

In Belgium and Germany a higher valuation is placed on the engineer's services and he is given greater freedom of opportunity. He is expected to bring innovations in his country similar to what is done in the United States.



# NEWS

Briefs of current interest to the consulting profession plus notes on new equipment in the field of engineering



## Primer for Vinyl Coating Applied Like Conventional Types

Desirable properties of heavy-duty, drying-oil primers are combined with chemical resistance advantages of vinyl coatings in a vinyl coating system developed by Prufcoat Laboratories, Inc.

Shown in the illustration are a column and steel ladder at the Kuehne Chemical Co. plant in Elizabeth, N. J. This plant manufactures sodium hypochlorite, which is highly destructive to all steel surfaces. Various coating systems, previously tried in an effort to control corrosion, failed in a matter of weeks. Mere vibrations in the plant were often sufficient to release large scales and sheets of rust. The photograph shows the steelwork 14 months after application of the company's new vinyl coating system. No signs of corrosion had appeared.

Key to the system is a newly developed primer, known as Prufcoat Primer P-50. In addition to possessing highly prized drying-oil properties, it is specifically formulated for use with active-solvent synthetics, and particularly with vinyl coatings.

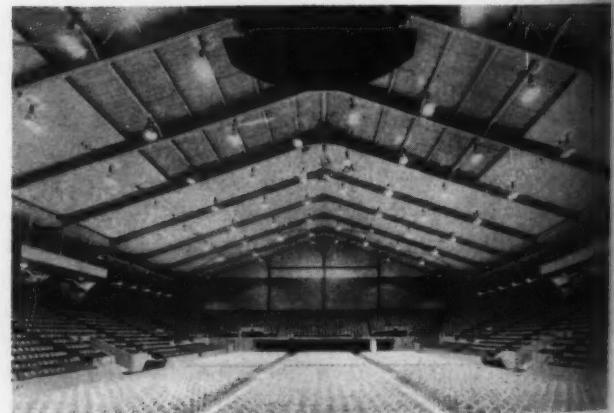
Studies with synthetic resin protective coating systems have shown that coatings build at a slower rate on prominences, so that it is necessary to establish a high thickness requirement for flat areas to insure a low probability of early failure. By affording substantially greater build at edges than previously possible with vinyl coating primers, the new material

safely lowers optimum thickness requirements for flat areas to 4 mils.

It bonds securely to most metals and, like primers of the red lead and oil variety, it also can be depended upon to perform satisfactorily over old, corroded, wire-brushed metal. In turn, the dry primer presents a surface to which any properly formulated vinyl-coating adheres with high tenacity. In addition, the primer bonds firmly to old paints, whether oil-base, rubber-base, vinyl, or oleoresinous.

Another important consideration that bears directly on long service life is the providing for control of underfilm corrosion and rust creepage. The drying-oil type vehicle used in the new primer, and its heavy pigmentation with zinc chromate and other inhibitive pigments, are said to qualify it in this respect.

Application of the new primer is said to be done exactly the same way as application of most conventional industrial primers.

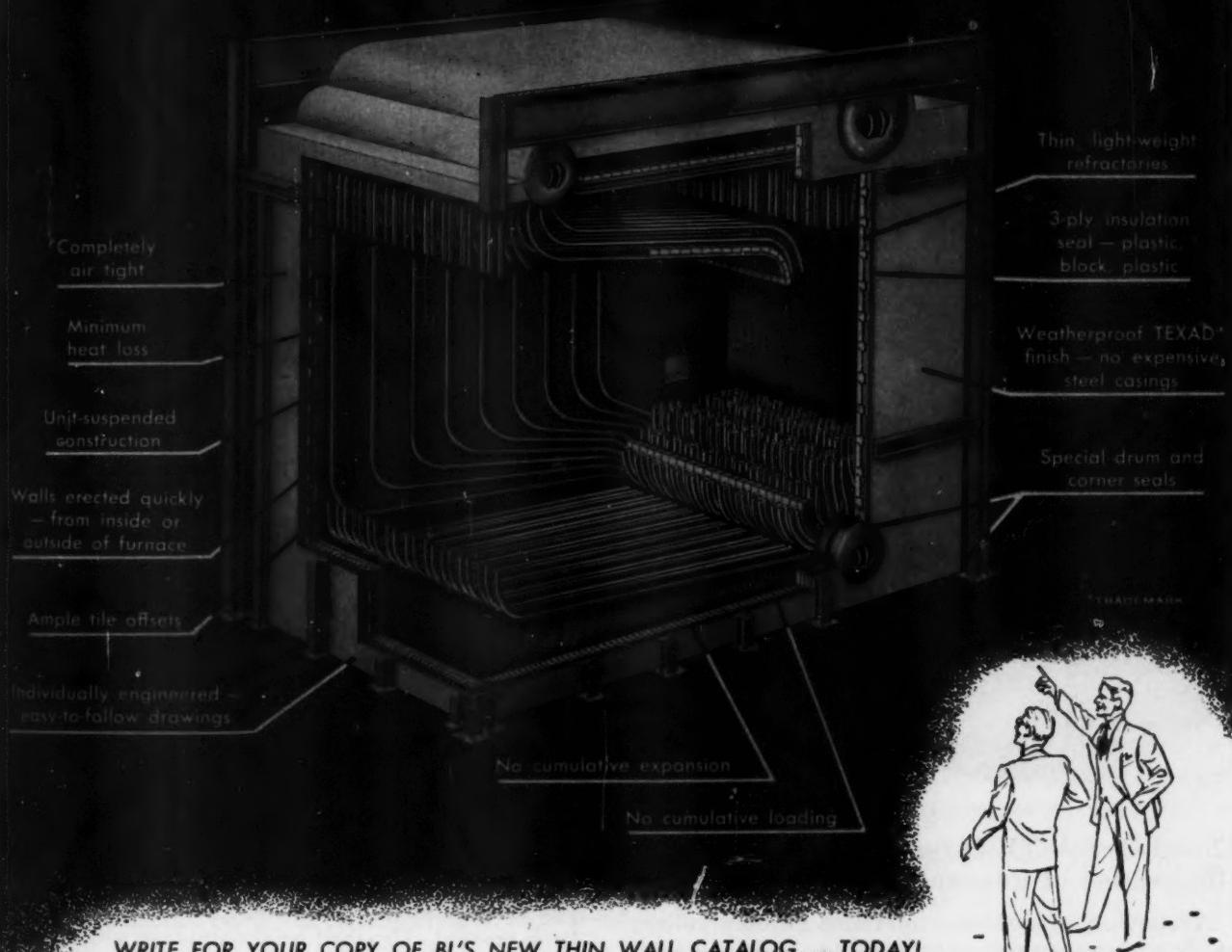


## Acoustical Treatment Solves Noise Problem in Large Auditorium

Expenditure of only \$22,000 for acoustical treatment of the Canton, O., Memorial Auditorium has licked a noise problem which threatened to make the huge \$1.2 million public building practically useless. Through proper treatment, echoes and re-

(Continued on page 11)

# *Look at all the advantages of B-L THIN WALL construction for Industrial Furnaces*



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## Auditorium Noise Problem Solved

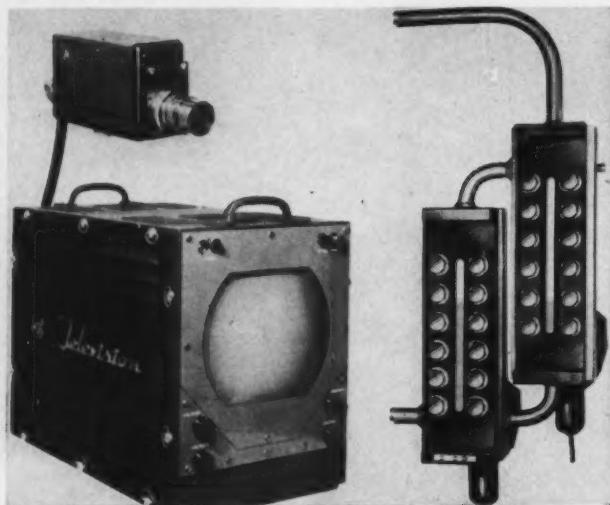
—Starts on page 56

verberations have been reduced to a minimum.

Two main problems were encountered in the auditorium, which includes 1,450,000 cu ft of space with a ceiling height of 60 ft in the center. They consisted of long-delayed reflections or echoes from the rear of the room, and excessive reverberation time.

Following recommendations of Bolt, Beranek and Newman, consultants in acoustics, a "restrained" installation was made. In order to assist in the proper distribution of sound, a large portion of the central forward part of the ceiling was not covered.

The project consisted of installing 25,000 sq ft of Fiberglas ceiling board, 2000 sq ft of Fiberglas white wool, and 1650 sq ft of Fiberglas perforated tile. Ends of the ceiling board were laid on the lower flanges of the steel roof purlins, with the sides supported by metal T strips extending between the purlins. Each board is 7 ft long and 1½ in. thick. The white wool was spread over the back wall to a height of 16 ft, and then covered with perforated transite to permit noise to reach and be absorbed by the wool. The remaining wall was covered with perforated tile.



## Closed-Circuit TV Permits Observation of Remote Boiler Gages

Availability of industrial television for observation of remote boiler water gages has been announced by Yarnall-Waring Co. An arrangement has been made with Radio Corporation of America to apply their industrial television equipment to installations of Yarway pressure sealed flat glass gages, thus permitting "live" gage readings at the operating panel or at any other convenient location in the boiler plant.

Television equipment consists of a small, lightweight camera connected to the viewing monitor by a single cable. This simplified two-chain unit is standard RCA equipment. The recent development of a small Videcon tube is reported to make possible the

manufacture of a camera approximating the size of a 16 mm home movie unit. A special camera base also is provided to furnish proper lighting of the gages.

Gage glass inserts are described as a pressure-sealed, "floating assembly" type. Greater flexibility is gained by using two independent inserts, and by interconnecting expansion loops. A short connection to the drum assures accurate gage readings, and the lower flanged connection eliminates a stuffing box.

Gage illuminators are the Yarway type M, which cause a brilliant point of light at the meniscus of the water level. It is said to be especially effective in penetrating deposits on the gage glass, dust particles in the air, and extraneous light.



VIEW SHOWS QUARRYING OPERATIONS AND KILNS REQUIRED FOR THE MANUFACTURE OF LIGHTWEIGHT AGGREGATE.

## New Facility Will Manufacture Lightweight Aggregate

Plans for the construction of a million dollar plant to produce lightweight aggregates has been announced by Southern Lightweight Aggregate Corp. Operation of the new facility, to be built in Acquadale, N.C., will be carried on by a subsidiary, The Carolina Solite Corp. The plant is expected to be in operation in about six months.

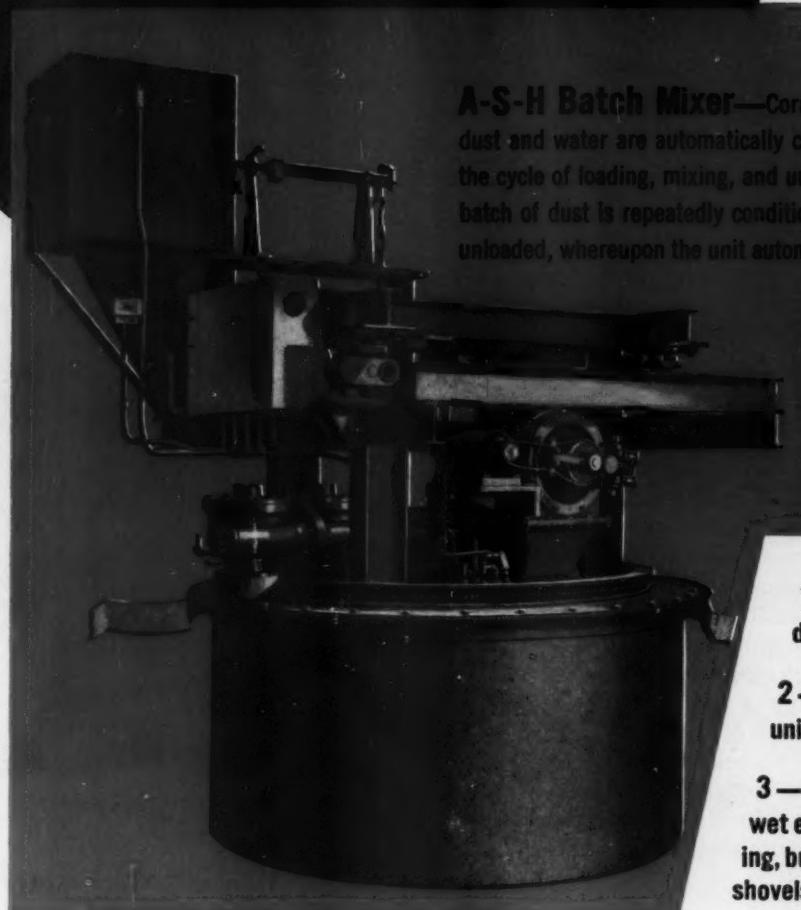
The product, known as Solite, is described as being a controlled lightweight aggregate used in place of sand, gravel, and crushed stone in the manufacture of concrete building units, structural concrete, bridge floors, and buildings. It is manufactured by a process similar to that used in the making of Portland cement. Crushed shaly-slate is processed in long kilns, where it is expanded under high heat, and then allowed to cool and anneal.

The controlled manufacturing process assures uniform consistency, and is said to offer many outstanding construction advantages. Concrete made with the product is 33 per cent lighter than that made with natural aggregate. Masonry units, in addition to being lighter in weight, are strong and durable, fire resistant, rust-proof, will absorb sound and noise, and have excellent heat insulation qualities.

(Continued on page 60)

CONSULTING ENGINEER

# Keep your DUST under control



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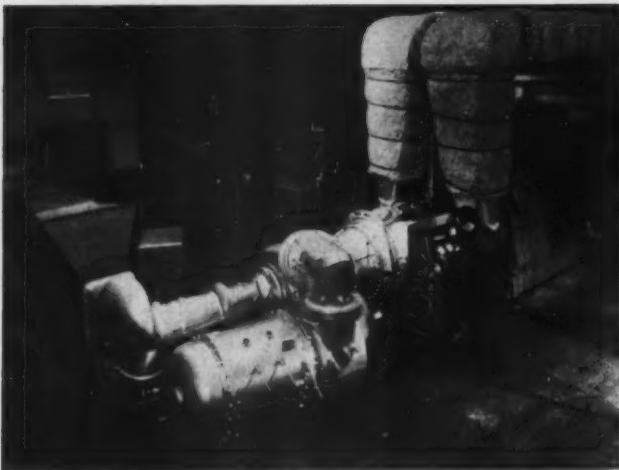
## HYDROJET

(hydraulic)

materials handling systems

## HYDROVAC

(pneumatic)



## British Gas Turbine Uses Peat as Fuel

Peat, lignite, and low grade coals may soon become an important source of commercial fuel as the result of recent developments in the industrial gas turbine field. Reports coming from England indicate that peat has been successfully used in a gas turbine manufactured by Ruston & Hornsby, Ltd. This development is part of a research program being carried out under the auspices of the Ministry of Fuel.

Preparation of the peat consists of reducing water content, first by a special method of pressing, and then by a drying process using the exhaust heat of the turbine. After drying, it is ground to a very fine powder and subjected to a "fluidizing" process before feeding into the turbine's combustion chamber.

## Large Nickel Deposit Is Discovered at Cuba's Moa Bay

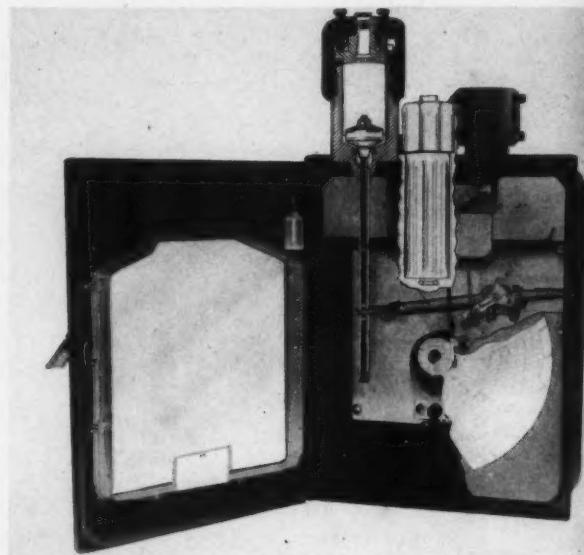
Discovery of a large deposit of nickel ore in the vicinity of Moa Bay, about 500 miles east of Havana, Cuba, has been announced by Freeport Sulphur Co. The deposit consists of at least 40 million tons of ore containing about 1.35 per cent nickel and .14 per cent cobalt. The company believes that, with the exception of certain deposits in Canada, the Moa Bay discovery will constitute the most important proven source of this critically short metal to be found anywhere in the free world.

In discussing the new discovery, J. H. Whitney, board chairman, stated that the Moa Bay ores could be readily treated by a process developed by Freeport for a government plant now in operation at Nicaro, Cuba.

As a result of improved techniques, however, the present process is not expected to be used. According to Whitney, Freeport has recently developed a new and better leaching process involving the use of sulfuric acid. In addition, Chemical Construction

Co., a subsidiary of American Cyanamid Co., has made important progress in the treatment of nickel and cobalt ores. Among their developments is a process for the production of nickel as a metal rather than oxide. Mr. Whitney stated that the combination of the sulfuric acid leaching process and the new metals technique represents a great improvement over the Nicaro process.

Freeport and Chemical Construction have concluded an agreement to collaborate in this field, according to Whitney. "The chemistry of the processes has been satisfactorily demonstrated. Freeport will now build a pilot plant to obtain engineering information for the design of a commercial plant to treat Moa Bay ores, and will pursue actively its plans for the construction of such a plant."



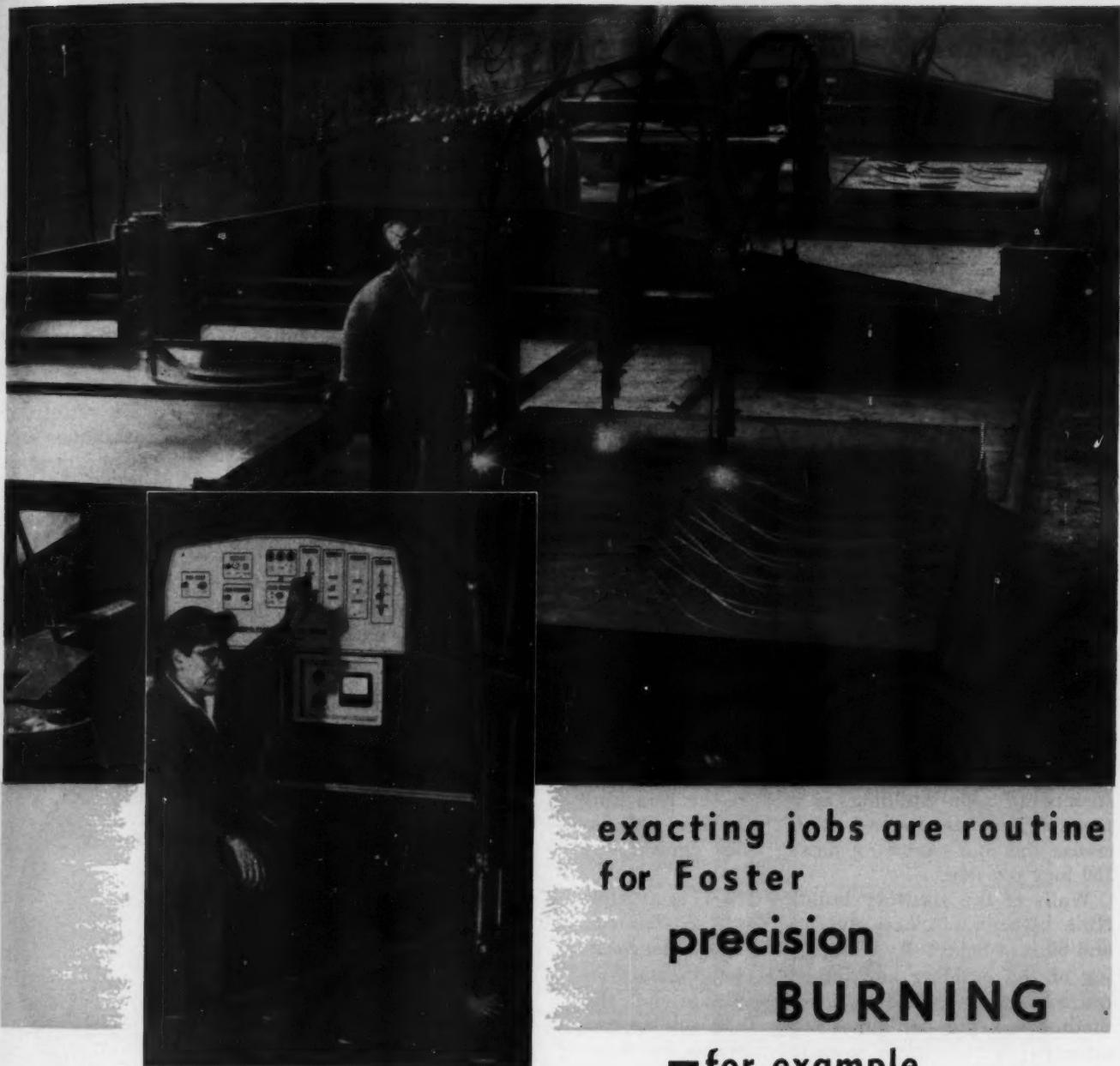
## High Pressure Mercury Manometer Eliminates Pressure-Tight Bearings

To eliminate all problems of pressure-tight bearings, lubricants, and fluid leakage, Fischer & Porter Co. has incorporated a magnetic coupling between the float and follow-up linkage of a new mercury manometer. The unit is designed for routine operation at pressures up to 5000 psi.

Stainless steel float and range tubes are employed to permit use directly with sour crudes and other corrosive fluids. A free-riding float, permitted by the magnetic coupling, seals against upper or lower O-rings in the float chamber to provide a check against loss of mercury on overrange. An inherent temperature compensating feature assures accurate measurement under varying ambient conditions. The manometer also is offered with a recorder which can be used with McGaughey-type continuous integrating mechanisms.

Applications for the new high pressure manometer are anticipated in petroleum and natural gas production, high pressure steam installations, and high pressure chemical and petroleum process reactions.

(Continued on page 62)



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# NEWS

—Starts on page 56



## Sliding Form Method Used To Construct Concrete Building

In constructing a new bleach plant for Hollingsworth and Whitney Co., The Rust Engineering Co. employed a sliding form method of concrete construction for the building, as well as the bleaching towers. The new facility, in Mobile, Ala., will increase the mill's existing bleach stock capacity by 150 tons per day.

Walls of the six-story building are  $7\frac{1}{4}$  ft high. Nine bleaching towers average 14 ft in diameter and 60 ft in height. Rust engineers report that pouring of the building and nine bleaching towers required ten days. The engineers estimate that this method is nearly ten times faster than similar construction with fixed or so-called movable forms.

The building was literally hauled up by its own screwjacks in a continuous lift operation. In this method of construction, 1 in. rods of special alloy steel are set vertically among the reinforcing rods in the concrete. A screwjack mounted on a yoke climbs each special jack rod by means of dogs. As the screwjack is turned, it elevates the yoke and an attached wooden form and working platform. The 20-ft jack rods are continuously extended, as the walls go up, by a pipe sleeve arrangement. Rate of climb depends on the setting rate of the concrete.

## Noise Reduction To Be Subject Of Special Summer Program

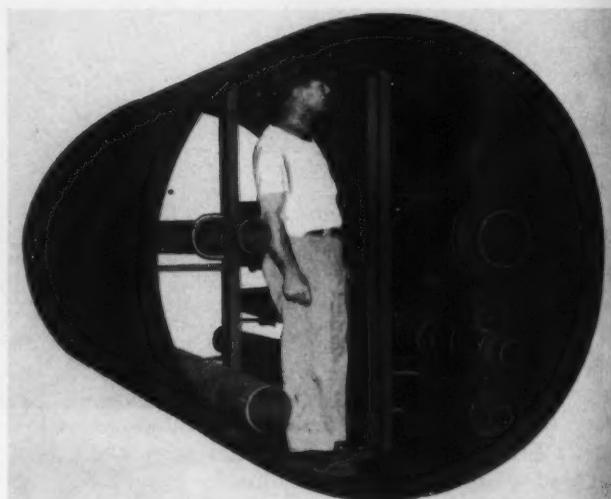
To give engineers and scientists a working knowledge of the means for noise reduction in buildings and industrial plants, a special summer program will be given in the Acoustics Laboratory at the Massachusetts Institute of Technology. The session, to be held from August 24 to September 4,

will be under the direction of Professor L. L. Beranek, Associate Professor of Communications Engineering and Technical Director of the M.I.T. Acoustics Laboratory.

Guest lecturers will include Dr. K. N. Stevens and Mr. S. Labate of Bolt, Beranek and Newman, an acoustical consulting firm, and others from industry and building research.

"The problem of noise reduction in industrial plants and buildings has skyrocketed to importance because of recent court decisions favorable toward workers with partial loss of hearing," Professor Beranek points out. "Simultaneously, architects have found their clientele demanding quieter living and working conditions."

Present methods of measuring a wide variety of noises will be presented, as well as techniques and materials for noise reduction. Lectures and demonstrations will cover basic terminology and concepts; measurement of noise; psychological aspects; room acoustics theory; noise reduction in rooms; transmission of sound through structures; characteristics of noise sources; materials and structures for noise reduction; mufflers and vibration isolators; and machinery and ventilation-system quieting.



## Prefabricated Tunnel System Protects Utility Services

To protect underground distribution piping and other utility services, Ric-wiL Co. has developed a large diameter conduit system. It is designed to meet such service tunnel requirements as are found in industrial plants, colleges, hospitals, and municipalities. Known as Utilidor, the system is completely fabricated to job requirements with distribution piping for steam, condensate, water lines, fire lines, or process purposes all in place. It includes any required insulation, and accessories such as traps, valves, and expansion devices.

Provisions can be made for electrical and communication cables, ceiling lights, walk-through space

(Continued on page 64)

## STAINLESS STEEL VALVE COMPARISON CHART

BASED ON 2" GATE	COOPER ALLOY	COMPETITORS		
		A	B	C
Ball and socket rotating type disc for positive seating with minimum galling	✓	✓		
Discs and seats designed for simple reconditioning in the field	✓	✓		
Centerless ground stock to cut packing wear	✓	✓		
3/4" minimum stem diameter to assure rigidity	✓		✓	✓
Deep stuffing box with six turns of 1/4" square packing	✓		✓	
Packing gland designed to deliver square, uniform compression	✓			
Two piece gland construction to prevent gouging of the stem	✓	✓		✓
Swinging eyebolts to simplify repacking and provide added safety	✓			
Simplified yoke nut construction to permit replacement without interrupting service	✓			✓
Grease fitting to eliminate friction on yoke nut during opening and closing	✓			
100% x-ray of vital cast components	✓			
A stainless steel valve designed and produced by stainless steel specialists	✓	✓		
Stocked in major industrial areas by nationwide distributor organization	✓		✓	✓
Rugged construction for tough corrosive service—compare these weights!	33-lbs.	28-lbs.	28-lbs.	24-lbs.
7" minimum diameter handwheel for simplified hand closing	✓			

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City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

## Prefabricated Tunnel System

—Starts on page 62

for inspection and maintenance, and conveyor systems between buildings.

Units are shipped in lengths of approximately 21 ft, with simple joint connections and fittings such as tees and elbows prefabricated to fit exactly into the conduit runs. Conduit diameters range from 36 to 84 in., depending upon the nature and number of services to be housed.

## Scientist Predicts Use of Solar Energy to Produce Electricity

Only detailed engineering remains to solve the problem of harnessing the sun's radiant energy for effective use by mankind, according to Dr. Marcus D. O'Day, Cambridge, Mass., physicist. It requires a practical compromise between what is scientifically possible and what is commercially feasible. O'Day believes he has an answer, including a method for storing the sun's energy and delivering it for useful power as needed.

He outlined his plan at a conference arranged by the Phoenix Chamber of Commerce to explore the possibility of obtaining necessary financing in Arizona. He estimated a possible solution could be reached in five years at a cost of approximately \$500,000. "Harnessing the sun can't be done on a shoe string," he said, "but within the next three to five years, someone will take the plunge."

The Chamber has more than a cursory interest in solar energy. Phoenix claims more sunshine than any other city in the U.S., but does not have the water, coal, or oil to provide power for industry.

Since the sun is seasonal and diurnal, O'Day believes that a method of storing energy must be used. He proposes the use of electrolysis for this purpose. When sunshine is available, energy from solar radiation could be used to separate the elements of a compound, which would then be stored for use as required. In another power plant, the elements would be allowed to recombine as a new chemical fuel.

O'Day suggests ordinary salt for this purpose. Both sodium and chlorine can be readily stored, and since sodium chloride's heat of formation is high, large amounts of energy could be stored in a relatively small space. Solar radiation could be used to supply the energy for melting the salt, as well as for the electrolysis itself. Aside from being plentiful and cheap, the salt could be resold commercially since it would become purified and suitable for table use in the electrolysis process. The end-product might conceivably pay the cost of producing the energy itself.

Working with molten salt, a theoretical efficiency of 70 per cent can be attained. A practical goal, in O'Day's opinion, would be 30 to 50 per cent of power actually available from heat. Using a 1000 ft diameter reflector to receive the sun's rays, he estimated it would be possible to produce 54,000 to 63,000 hp hr per day of mechanical power, based on Phoenix's

annual mean of 530 Langleys solar radiation, and an average of 9 hr sunshine daily.

Among steps necessary for reaching a practical solution, O'Day listed the development of a reflector to provide maximum efficiency. In the desert, wind and dust create a serious problem. Some way would have to be found to keep the reflector clear. Again, O'Day emphasized that this is an engineering problem in which a compromise would have to be made between cost and efficiency.

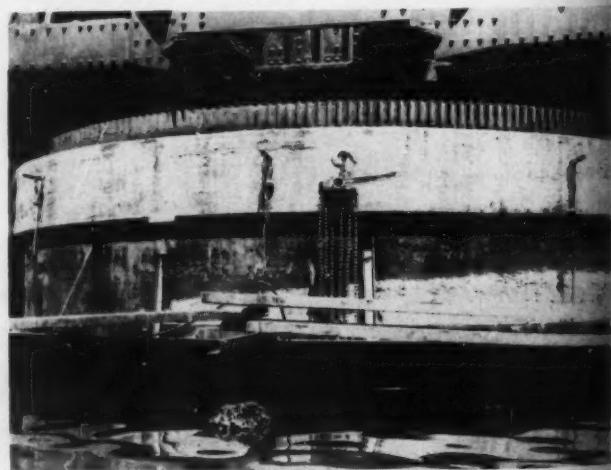
## New Organization Will Encourage Utilization of Atomic Energy

Incorporation papers for an organization known as the Atomic Industrial Forum, Inc., have been filed in New York state. The organization consists of businessmen, engineers, scientists, and educators who are interested in the industrial development and application of atomic energy for peaceful uses.

Formation of the association has resulted from a proposal by Dr. Glennan, made shortly after he resigned as a member of the Atomic Energy Commission and resumed the presidency of Case Institute of Technology. He suggested that an organization of business and other interests concerned with non-military development of atomic energy, should be formed to help further the advancement of this energy source. It should be independent of government, and the over-all result of its activities should be to further the development of this new industry.

The Forum will have its present headquarters in the Engineering Societies Building, 29 West 39th

(Continued on page 70)



ADDED PROTECTION FOR BRIDGE PIER

A. M. Byers Co. reports the use of wrought iron to check disintegration of a concrete pier supporting the B&O Railroad's Bear Creek Swing Bridge in Baltimore. The pier was encircled with a plate and sealed at the bottom with angles, both of wrought iron. Disintegrated material was then replaced with new concrete, and the wrought iron form was left for added protection. The Masonry Resurfacing and Construction Co. was the contracting firm.

5



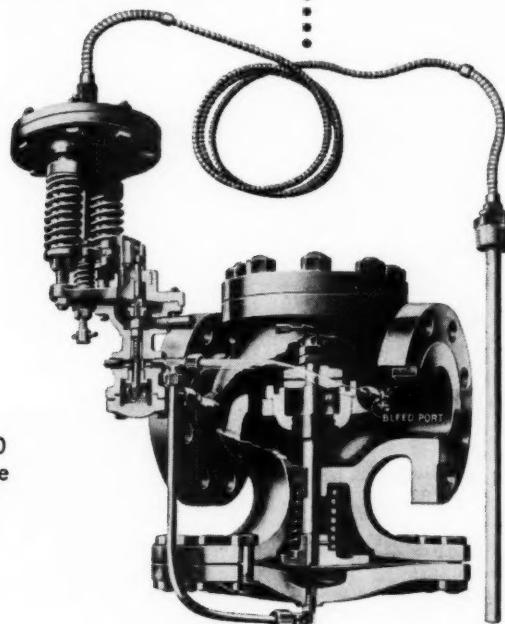
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Type ET150  
Temperature  
Regulator



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other design  
features:*

**Spence**

**SPENCE ENGINEERING  
COMPANY, INC.**  
WALDEN, NEW YORK

In the Spence Regulator, the springs are out of the path of the steam or other fluid flowing through the valve. They operate at low unit stress for exceptionally long life. This is only one of the many Spence design features that assure dependable, accurate regulation year after year. That means less down-time, less time and money wasted on replacement of parts.

Spence makes a wide line of automatic regulating valves: Pressure, Temperature, Differential Pressure, Back Pressure, Pump Governor and many other types. Write for bulletin 100 giving full details.

**SECO METAL SEATS AND DISCS—**  
Durable SECO Metal resists wire-drawing.  
More than twenty years of experience  
in thousands of installations has failed to  
produce a single case where SECO Metal  
has been cut by steam.

**LARGE BALANCED METAL DIAPHRAGM**  
located in a cooled zone with a condensate  
seal above and below it, never has to  
be replaced under normal conditions.

**PACKLESS CONSTRUCTION—**All Spence  
main valves and most pilots are built  
without stuffing boxes. This minimizes  
friction . . . reduces valve stem wear  
and eliminates time-consuming maintenance.

## Selecting Contractors

—Starts on page 20

\$25,000 can go into estimating the cost of the construction job. Seventeen to eighteen hundred field orders were issued for changes during the course of construction on a major project recently completed by Daniel Construction Co. While this number is not unusual on a large, complicated project, it is evident that a general contractor must be reimbursed by someone for the additional overhead required to figure these changes on a lump sum basis. Since this project was handled on a fixed fee basis, however, the contractor made no changes in his fee, for his original contract was based on a completed plant to obtain a specified production. Needed changes were accepted and effected as ordered, without the necessity of advanced detailed estimates and the costly delay of fully estimating each change and adjusting an original lump sum bid.

The larger and more complicated the project, the more difficult it is to do a speedy, economical job on a lump sum basis. The more changes ordered during construction, the greater the expense to the owner. These expenses are shared by the engineer, however, in the form of additional overhead involved in submitting the more detailed plans required by the contractor working on a lump sum basis.

By close liaison between the engineering firm and the contractor's field organization, many details can be completed in the field without the engineer submitting detailed drawings. With the contractor's field organization on hand to provide information on construction costs and methods as needed by the engineering firm's field staff, very considerable sums can be saved during construction by simple changes in procedure which will in no way detract from the final effectiveness of the project. This method has proven successful in many major industrial engineering projects and has saved thousands of dollars in engineering drafting and detailing time which might otherwise have been required.

### Saving Time

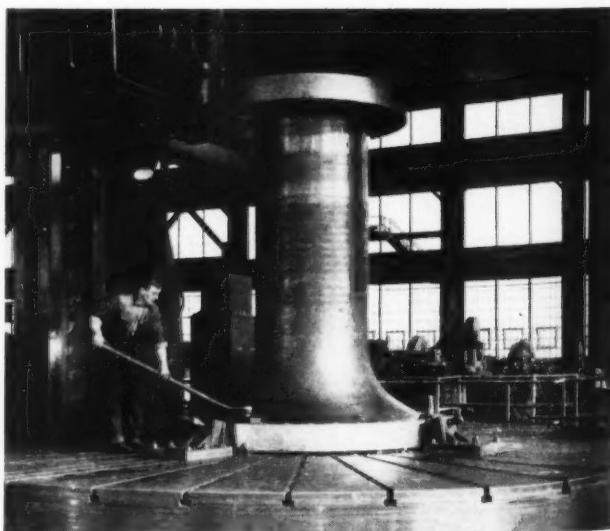
Too much emphasis cannot be placed on the speed with which a project can be completed when construction begins at the same time as engineering. In many instances, the short time in which construction of a plant can be successfully completed on a fixed fee basis represents tremendous savings for the owner and future occupant that far outweigh any apparent savings of a lump sum job. Also, by speeding the whole construction process, considerable money can be saved in interest on capital tied up during the construction. Of even greater importance where competitive markets are at stake, the owner is able to place his product on the market several months sooner.

The reputable contractor's interest is identical

with that of the engineer and the owner. He wants to see the best possible construction program completed in the least possible time and at the lowest possible cost. Because he is frequently consulted by the owner when the proposed project is in the first stages of planning, however, it is often the engineer who can best convince his client of the advantages of selecting the general contractor soon enough so that his services can be used during the early design period. In urging the client to select the contractor at the beginning, the engineer should stress the thousands of dollars that can be saved by getting the plant quickly into production. He should emphasize the advantages to the owner of inspection and control by two separate organizations, expert in their fields, and he should point out the possibility of placing undivided responsibility for the success of the project in the hands of an owner.

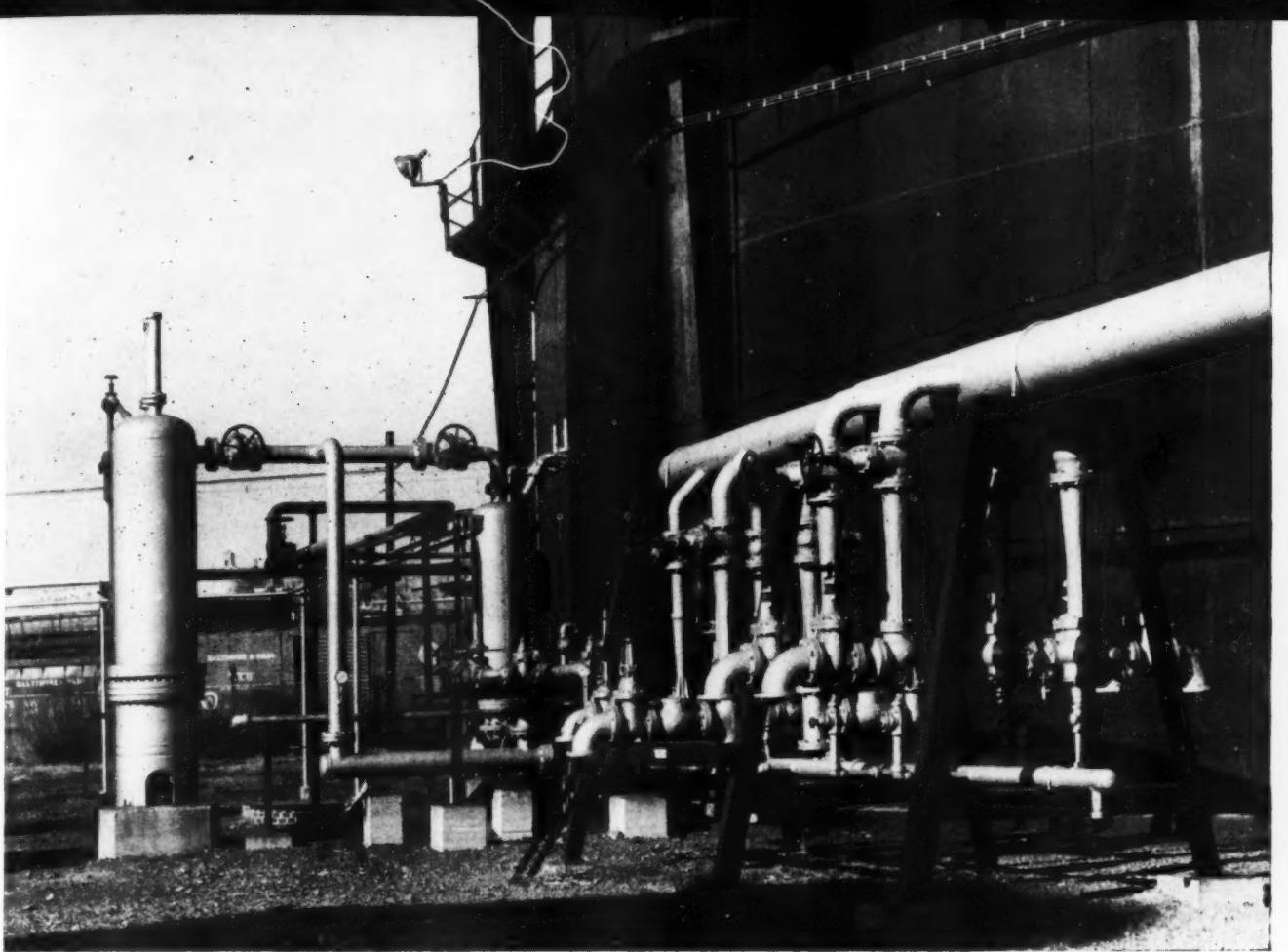
Once this association has been arranged by the owner, the engineer can further contribute to the success of the project by consulting with the contractor during all phases of the construction program, helping to establish a centralized command by the contractor in the field, keeping him posted as to contemplated revisions even prior to the blueprint stage, and channelling the wishes and instructions of the owner through the engineer.

By so streamlining the entire construction program, the engineer will increase his reputation for speed and efficiency. His contribution to the coordinated efforts of all parties during every phase of the construction program will improve and protect his reputation as an outstanding engineer or architect.



Giant shaft for hydro-electric plant

Being removed from a vertical boring machine at Bethlehem Steel Co. is a 38 ton intermediate shaft for the giant hydroelectric plant at McNary Dam. The \$280 million dam on the Columbia River will make a substantial contribution toward vital Pacific Northwest power by operating 14 generators with a total capacity of nearly one million kilowatts.



THIS IS A LARGE VOLUME, VENTURI TYPE MIXING UNIT FOR LP GAS. THE VERTICAL UNIT AT LEFT IS A VAPORIZER.

## LP Gas Standby Plants For Users of Natural Gas

ARTHUR E. WASTIE

Vice-President and Chief Engineer  
H. Emerson Thomas & Associates, Inc.



Mr. Wastie has been in the gas industry for over twenty-one years. He is recognized as an authority on the design of plant and storage facilities for both manufactured and

LP gas. He is a member of A.S.M.E. and the A.G.A., is a registered professional engineer, and has contributed many articles to technical magazines over the past years.

### MANY ADVANTAGES of natural gas for industrial

purposes assure a tremendous demand for it, but frequently the utility or pipe line company is forced to curtail gas supply to industrial concerns on their lines because of line leaks, compressor failures, peak loads due to increased domestic use, or other factors. Because of this curtailment problem a standby fuel may be required.

Industrial concerns need a standby fuel which will require the minimum amount of supervision; can be used in the existing natural gas burners;

can be mixed in varying percentages with the natural gas; has somewhat similar flame characteristics; and will require no burner adjustments or cause special maintenance problems. Propane and butane both meet those requirements, and they can be mixed in certain proportions with air to give many natural gas characteristics.

Whenever the utility company has only sufficient gas available for residential purposes, the supply to industry is curtailed. This curtailment can bring hardship for industrial users—loss in production,

interrupted processes, and labor cutbacks. Labor cutbacks, in turn, can cause a feeling of unrest among the workers, loss of pay, and the resultant upset of the economics of that industrial area. Therefore, it is wise for an industrial plant having natural gas as its fuel to consider very strongly the installation of an LP gas standby plant.

LP gas standby plants consist primarily of a storage tank, a vaporizer, a regulator station, and some form of diluting or mixing equipment. This is the fundamental equipment required, but many design features must be considered to bring about the proper engineering arrangement of such a plant.

#### Storage Tank

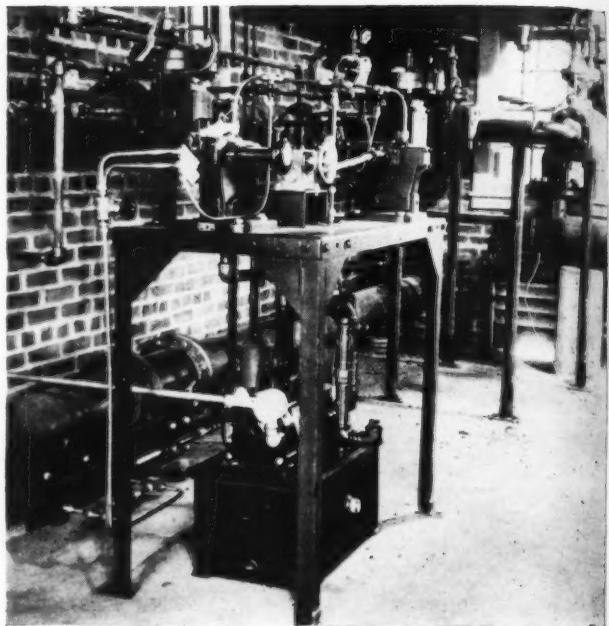
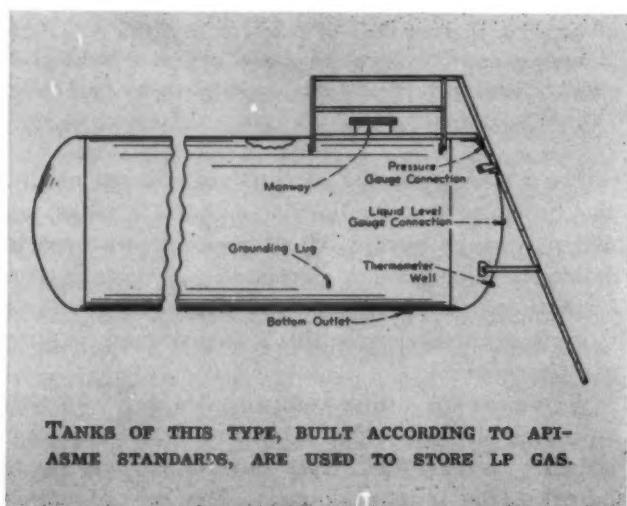
The major consideration in the design of a propane storage system is provision of sufficient storage to supply fuel needs during a maximum usage period in which natural gas might not be available. Reserve storage is also needed. It is good practice in the industry to calculate reserve storage capacity as approximately one month's usage without a fuel delivery.

For details relative to the actual design of LP gas containers reference should be made to the ASME Unfired Pressure Vessel Code or to the API-ASME Pressure Vessel Code, 1950. It should also be noted that no liquid storage container shall exceed 30,000 standard U.S. gallons in capacity.

The storage tank should be equipped with a man-hole, manhole cover plate, sufficient openings to allow for relief valve connections, liquid filling and unloading connections, and sufficient vapor connections to allow for compressor suction and discharge lines and vapor withdrawal.

#### Storage Tank Fittings

All openings on an LP gas container must be equipped with back pressure check valves or excess flow valves. Design and capacity are based on the statement in NBFU Pamphlet 58, paragraph B6:



THIS MIXING EQUIPMENT FOR LP GAS IS OF THE VARIABLE LOAD, ADJUSTABLE ORIFICE TYPE.

"The connection or line, including valves, fittings, etc., being protected by an excess flow valve shall have a greater capacity than the rated flow of the excess flow valve." With such design, if a break occurs in the gas line, the pressure differential between the storage tank and atmosphere will cause the excess flow valve to close. If the line had a smaller capacity than the excess flow valve, no shut off would occur.

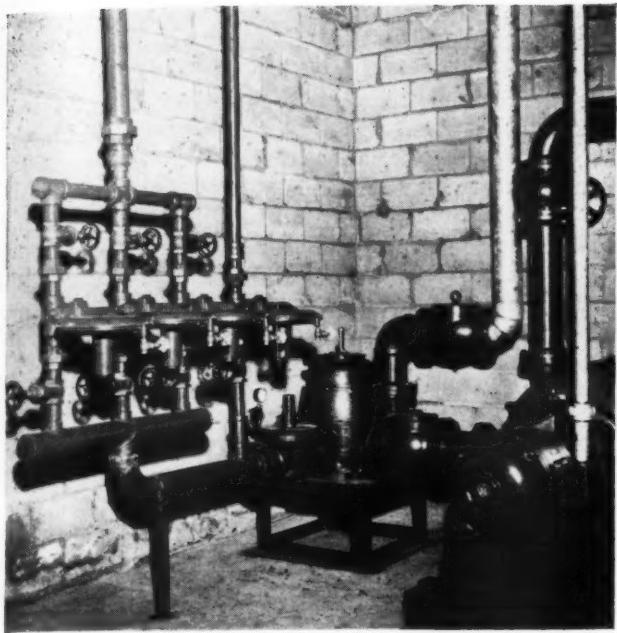
The various valves connected to the openings on the LP gas container should be designed for 300 lb water-oil-gas service, and the globe or angle valves so used should be of a material impervious to the action of LP gas. Neoprene discs are normally used for this type of service.

Every LP gas container must be provided with one or more safety relief valves and the rate of discharge must be in accordance with provisions of Appendix A, NBFU pamphlet 58. Each relief valve should be plainly and permanently marked.

#### Vaporizers

Most industrial and utility propane plants require a vaporizer for the liquid propane or butane. The necessity for a vaporizer is determined by such factors as maximum demand for gas, size and location of storage tank, minimum amount of liquefied gas carried in the storage tank, climate conditions, and plant gas pressure required. The size of the vaporizer is determined from the maximum hourly demand. It may be of the steam, hot water, or direct fired type.

All vaporizers are equipped with suitable automatic means to prevent liquid from passing from vaporizer to gas discharge piping. This is normally done by a liquid trap in the gas outlet line; by a liquid level



A VARIABLE LOAD, POWER DRIVEN RATIO CONTROLLER USED FOR MIXING AIR AND LP GAS.

controller and positive shut off of liquid inlet line; or a temperature control unit for shutting off the liquid line in the event of low temperature conditions occurring within the vaporizer.

#### Regulator Stations

In any gas plant operation, regulator stations are a necessary part of the controls, and when designing an LP gas installation, it is well to have regulator stations in duplicate equipped with necessary blocking or shut off valves so that one regulator may be taken out of service for necessary repairs without closing down the entire system.

It is necessary to correct regulator capacities when making LP gas applications, as most sizing charts and manufacturers' data books are based upon the specific gravity of air or the specific gravity of natural gas.

#### Mixing Equipment

There are three generally used types of mixing equipment: the inspirator or venturi tube; the ratio controller; and the orifice unit. The inspirator type mixer is economical, requires no power, and is discharged at a fixed pressure. It generally requires the use of a surge tank, it should not be throttled, and it is used either wide open or completely closed. This design uses a jet to accomplish the mixing, and it is possible to combine a number of jets to give a wider throttling range.

Ratio controllers have the advantage of a wide range of flow; they are easily adjusted to vary the air-gas ratio. However, their use is generally limited to low pressure discharge, and they require an electric motor or other source of power for operation.

Orifice plates, either fixed or adjustable, are excellent for high pressure, large volume loads, and they have a wide range of flow. They do, however, require the use of compressors for air and gas mixing.

#### Unloading Equipment

In the design of LP gas systems, consideration must be given to unloading liquid either from tank car or tank truck. An unloading rack, with sight glass, check valve, and line valves must be installed and adequately protected from possible truck or car damage. Liquid and vapor unloading hoses are of material resistant to LP gas and are designed for five times the working pressure.

The generally accepted practice for unloading liquid propane from tank car to storage tank or tanks is by the pressure differential method using the compressor designed for LP gas service. This permits the flow from tank car to storage tank by reducing the pressure in the storage tank and increasing the pressure at the tank car. At the completion of this operation residual vapors are taken from the tank car and returned to the storage tank, by reversing the valve controlling the compressor suction and discharge.

On tank truck unloading, the liquid is normally transferred from the tank truck to the storage tank by means of the liquid transfer pump which is part of the transport equipment. Using this method of unloading, the liquid content of the truck is gauged at the start and at the completion of the liquid transfer, and in some cases a meter record is also incorporated.

#### Safety Requirements

It is well to remember that installation of LP gas equipment requires considerable experience to assure a satisfactory system. The consultant and his customer should be familiar with the equipment required and the design specifications to which it should be built, but there are companies specializing in this type of work who can be called upon for assistance. Also, the layout should be examined and approved by an insurance company or state inspection agency to make sure that the design meets all safety requirements.

The distributors of natural gas, the pipelines and the utilities, are doing all they can to supply the peak demands of their customers, both residential and industrial. Natural gas is being burned in this country at the rate of about 9 trillion cu ft per year—against only 2.5 trillion cu ft in 1937. This growth, in itself, puts a great strain on the industry, and there is just no way they can assure a supply of gas to all users at all times. Some utilities use underground storage areas for natural gas, but only a few have been able to locate such areas within reasonable distance of the market. Today, and for many years to come, the way to assure a constant fuel supply is to install an LP gas standby plant.

## New Atomic Energy Organization

—Starts on page 64

Street, New York. Listed among the members of the Board of Directors are: W. L. Cisler, president of The Detroit Edison Co.; Dr. M. E. Putnam, exec. vice president of The Dow Chemical Co.; A. Iddles, president of Babcock & Wilcox Co.; J. L. Collyer, president of B. F. Goodrich Co.; Dr. T. K. Glennan, president of Case Institute of Technology; and Admiral E. W. Mills, president of Foster-Wheeler Corp.

Purposes for which the Forum is being organized are four-fold, according to the incorporation certificate. They are: to foster and encourage the development and utilization of atomic energy in accordance with the best traditions of American democracy and free competitive enterprise; to provide a forum in which individuals and organizations may consult and cooperate in the resolution of problems which are of concern to the nation, to industry, and to the public generally; to promote the dissemination, to an extent consistent with national security, of knowledge and understanding relating to development and utilization of atomic energy; and to foster and encourage research and development.

## Boiler and Turbo-Generator Will Operate Above Critical Pressure

Plans to build a boiler and turbo-generating unit for operation in the super-critical pressure range have been announced by American Gas and Electric Co. The unit, expected to be the most efficient ever built, will mark the first time the critical pressure barrier has been exceeded in commercial production of electric power.

After many months of study and preliminary design, an agreement has been reached under which General Electric Co. will design and manufacture a 120,000 kw turbine for operation at 4500 psi, almost double the present highest steam pressure utilized for power generation. Initial steam temperature will be 1150 F, about 50 degrees above the present highest. It will be followed by two stages of reheat, the first at 1050 F, and the second at 1000 F.

The steam generator, to be built by Babcock & Wilcox Co., will be the once-through, Universal-Pressure type. In this type, water at 5500 psi is pumped through and changed into superheated steam in a single, fast passage through the boiler tubes. It will be equipped with cyclone furnaces.

The entire project, cost of which will exceed \$12 million, is being engineered by American Gas and Electric Service Corp., a subsidiary of AGE. The unit will be installed under Service Corp. supervision at The Ohio Power Company's Philo Plant near Zanesville, O. Ohio Power is an AGE operating company subsidiary.

In commenting on the project, Philip Sporn, president of American Gas and Electric Co., pointed out that this project is the consummation of more than

30 years of continuous work and development. "While boilers above the critical pressure of 3206 psi had been considered before, and while laboratory pressures above that value had been utilized," Sporn said, "no practical design had ever been developed." He explained that, in the super-critical pressure range, water passes immediately into steam without any intermediate stage of bubbling.

In the once-through boiler design, the steam drum and re-circulating pumps are not required. In effect, the boiler becomes a continuous run of tubing into which water is pumped at one end with highly superheated steam being delivered at the other end.



## Light Weight Generator Provides Independent Source of Electricity

To provide electricity beyond the limits of power lines, Porter-Cable Machine Co. has developed a light-weight, gasoline driven generator. In addition to supplying power for electrical equipment on construction projects, the manufacturer also recommends its use as a mobile power source for flood lighting or as a standby emergency power plant.

Two models are available. Both have 3 hp, single-cylinder engines, and are described as being compact enough to fit in the trunk of a car. Each unit has four electric outlets. One model is a 1.5 kw, d-c generator supplying 115 v at 13 amp. It weighs 75 lb and can be carried in one hand. The second, an a-c generator, weighs 135 lb and is equipped with a two-man carrying handle.

## Instrument for Measuring Smoke Density Aids Air Pollution Studies

Greater interest in the prevention of air pollution has increased the need to observe the density of smoke issuing from stacks. A new instrument, called the smokescope, has been developed to eliminate the causes of error inherent in methods presently used. This instrument was described in a paper by N. W.

Hertz, physicist for Mine Safety Appliances Co., and presented at the Spring Meeting of the American Society of Mechanical Engineers in Columbus, Ohio.

Estimation of smoke density is usually made by visual comparison with shaded standards of a Ringleman chart. The trouble with this method, according to the paper, is that the observer must take into account the variations in lighting and background against which the smoke is viewed, as well as the illumination of the chart.

In the smokescope, a reference film disc is viewed against the background adjacent to the stack in order to eliminate the effect of differences in lighting. In this manner, the smoke and the reference film receive light from the same source, thus density estimations are not affected by background variations or by brightness of the day.

To further improve the accuracy with which estimations can be made, a lens is used to project a visual image of the reference standard to a focal distance equivalent to that of the stack. This makes it unnecessary to refocus the eye while making a comparison. The stack is viewed through three aligned apertures in a closed, tubelike section, thus preventing entrance of stray light by limiting the field of vision to the area of the stack. The aperture nearest the eye is the unsilvered center spot of a mirror. Reflected on the remainder of this mirror, by means of a second mirror and lens, is an image of the film showing the shades for various densities of smoke. The eye therefore compares the smoke and surrounding reference film without needing to change focus.

#### Utility Contracts for Controlled-Circulation Boiler

The advance in boiler practice during the last twenty-five years is illustrated by a contract recently closed by Combustion Engineering Inc., to furnish the boiler for a new generating unit at the State Line Station of the Commonwealth Edison Co. system. The station is located at Lake Michigan and the Illinois-Indiana border.

Designed around 1926 and officially placed in service in the summer of 1929, this station attained widespread attention because it contained the largest steam turbine in existence—a 208,000 kw, three-element machine operating at 600 psi, 730 F superheat, with 500 F live steam reheat, and served by six 450,000 lb per hr sectional header boilers. In fact, this turbine size has not been exceeded to date, although larger machines are on order.

The new cross-compound turbine-generator now on order will be rated at 191,000 kw. Although comparable in size to the earlier unit, it will be served by only one boiler instead of six. Nominal steam conditions will be 2000 psig at 1050 F primary and 1050 F reheat temperature at the turbine. The boiler will be a 1,350,000 lb per hr controlled-circulation, reheat type with a twin furnace, platen-type superheater, and corner firing with tilting tangential burners for steam temperature control. It will be served by eight

bowl mills, and will have three air preheaters of the Ljungstrom regenerative type. It is scheduled for operation in the fall of 1955.

#### Underground Water Used to Condition Air in New Hospital

An air conditioning system utilizing radiant energy and subterranean water is featured in the ultra-modern \$7 million Long Island Jewish Hospital now under construction in Glen Oaks, N. Y.

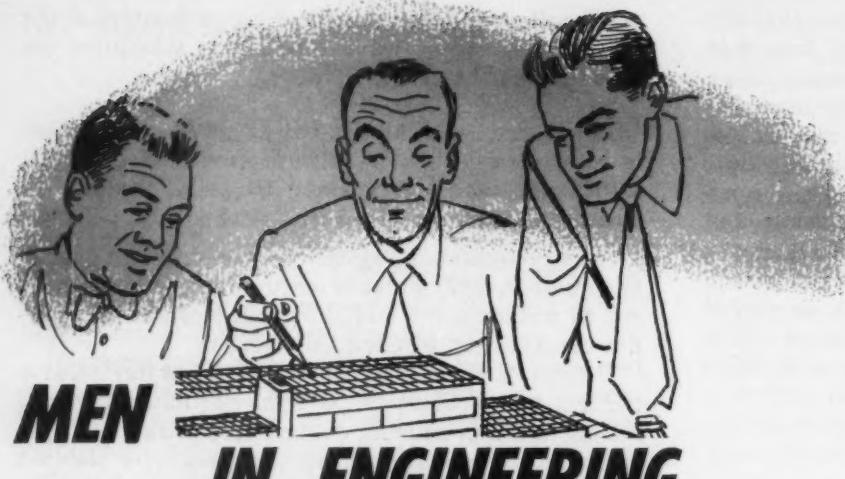
During the summer, underground water with a natural temperature of 50 F is circulated through ceiling and wall coils for cooling. According to Louis Allen Abramson, New York architect who planned the new building, the method of cooling without aid of refrigeration is completely new.

In winter, the same coils are utilized for circulation of heated water. An elaborate control system, developed by Minneapolis-Honeywell engineers, utilizes some 300 thermostats to individually regulate the panel heating or cooling in each room. Water for the radiant panels is pumped from the earth by a modified heat pump arrangement that is expected to markedly reduce fuel bills.

Construction of the building, being handled by Turner Construction Co., is expected to be finished in August. Although it will be only five stories high at that time, provisions have been built in to permit the addition of four stories at a later date.

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## MEN IN ENGINEERING

★ Appointment of W. Brill as director of engineering for The Colorado Fuel and Iron Corp. is announced.

★ Directors of United Engineers & Constructors, Inc. elected F. N. Floyd and A. G. Middleton as vice presidents and directors. J. N. Rols-ton also was named vice president.

★ E. F. Patterson, a construction engineer for the past 26 years, joined the executive sales staff of the Luria Engineering Co.

★ Henry J. Gazon & Associates announces the opening of additional facilities at 55 W. 42nd St., New York 18.

★ C. H. Welling and G. H. Woodard announce the formation of Welling & Woodard, industrial consultants and management engineers. The

firm will specialize in new products and diversification. Offices will be located in New Canaan, Conn.

★ B. T. Svhel is placed in charge of the new electronics division established by The Kuljian Corp.

★ Tammen & Denison, Inc. announces an expansion of their electronics department. Many electronic engineers have been added and service facilities expanded to meet the need for a broader and more comprehensive program in the development and application of electronic measuring equipment.

★ Expansion of the engineering and architect's advisory service of Solar Light Manufacturing Company is announced. The service is geared to furnish engineering and design data to aid in solving a specific lighting problem.



SANTRY

ISENBERG

★ Combustion Engineering—Superheater, Inc. has shortened the company name to Combustion Engineering, Inc. The following officers were elected to new posts: J. V. Santry, president, is chairman of the board and will continue as chief executive officer; S. G. Allen retired as chairman of the board but will continue as chairman of the executive committee; M. H. Isenberg, executive vice president, is named president.

★ W. A. Brecht is appointed consulting engineer for Westinghouse Electric Corporation's Atomic Power Div. He moves to his new post from that of consulting engineer to the vice-president in charge of the East Pittsburgh plant. A new plant near Pittsburgh to house the newly-formed Atomic Equipment Dept is expected to be completed this year. Appointment of four men to key positions in the dept is announced. They are L. B. Dorsner, supervisor of manufacturing; R. M. Yearick, supervisor of production; J. L. Ackerman, administrative assistant to the department manager; and Benjamin Cametti, manager of the pump engineering section. W. W. Wendelken is named director of works engineering for the headquarters manufacturing division.

★ K. Brunner resigned from the position of associate highway engineer with the California State Division of Highways to accept the post of chief design engineer with the firm of Francis H. Bulot, consulting engineers, of Los Angeles.

★ H. J. Allemand is appointed vice-president in charge of planning for Philco Corp. Prior to his joining Philco 13 years ago, he was senior partner of Stevenson, Jordan and Harrison, Inc., management consultants.

★ M. D. Church, consultant for the Worthington Corporation at their Wellsville Works, announces his retirement after 29 years' association with the firm. W. O. Wilson, commercial vice president, also has retired after 53 years' service with Worthington and its predecessor companies.



JUDGE W. A. KELLY,  
E. H. PEABODY, AND  
E. G. PETERSON, of Peabody Engineering Corp., at the airport as Peabody and Kelly leave for London. They will study European combustion problems and investigate the possibility of a natural gas pipeline from the Red Sea region through continental Europe to England.

★ A. M. Sargent, founder and former president of the Pioneer Engineering and Manufacturing Company who recently resigned his interest in that firm, announces the opening of his own consulting engineering office at 10120 West McNichols Road, Detroit 21.

★ Formation of the consulting engineering firm of Eichwald Associates, 237 East 39th Street, New York and New Haven, Conn. is announced. Combined with B. Eichwald are structural, mechanical and sanitary engineers, to provide coordinated engineering services in planning, design, supervision of construction, operations, maintenance and cost analysis.

★ W. S. McDaniel is appointed chief engineer, eastern district, for The H. K. Ferguson Company. During the past six months he has been project engineer for a large plant expansion in Cuba.



MC DANIEL

GAY

★ C. H. Gay, vice-president and formerly head of the manufacturing dept of the Boiler Div., is placed in charge of The Babcock & Wilcox Company's new Atomic Power Div. W. H. Rowand, chief engineer of the Boiler Div., is elected a vice president. P. R. Loughin, formerly chief of staff engineering and executive assistant, is transferred to the staff of the Boiler Div.

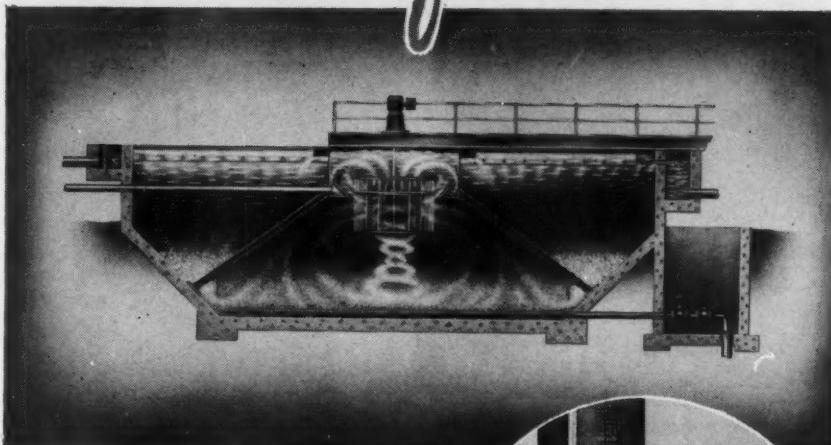
★ W. D. Canan, chief mechanical engineer of The Rust Engineering Company, retired May 1st after 28 years' service. He has been active as an engineer for over 43 years.

★ Lindberg Steel Treating Co. announces a \$2 million expansion program. The new building, designed especially for commercial heat treating, is being erected by Clearing Industrial District, Inc., from plans by J. S. Cromelin.

★ L. T. Mart, president of The Marley Co., was elected president of the Cooling Tower Institute at the recent annual meeting. Other officers elected for the 1953 terms were N. B. LauBach of Hudson Engineering Corp., vice-president; P. R. Hoffman of Lilie-Hoffmann Cooling Towers, secretary; C. E. Pickup of The Fluor Corp., treasurer.

MAY 1953

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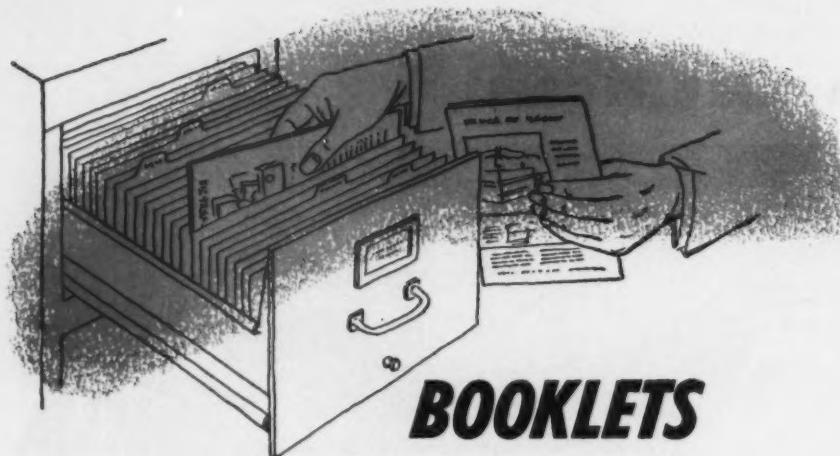
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HYDROGEN SODIUM ZEOLITE SOFTENERS • DEMINERALIZERS • CHEMICAL FEEDERS • CONTINUOUS BLOWDOWN • SWIMMING POOL EQUIPMENT



**SOUND MEASUREMENT EQUIPMENT** is described in 12-page bulletin KEM 155211. In addition to describing several types of sound analyzers, the booklet explains how the instruments are used. Advantages and specifications are presented. *General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.*

**ACOUSTIC PANELS**, developed to meet many types of noise reduction applications, are discussed in 4-page folder C 4. Units can be supplied as standard panels, or fabricated to meet special requirements. Absorption coefficients are tabulated. *Industrial Acoustics Co., Inc., 333 Jackson Ave., New York 54, N. Y.*

**RADIANT HEATING**—How a ceiling heats and cools radiantly, and provides acoustical control, is explained in 4-page folder A-109. Construction of the ceiling is shown, and the principles of radiant heating and cooling are explained. *Burgess-Manning Co., Architectural Products Div., 5970 Northwest Highway, Chicago 31, Ill.*

**UNPLASTICIZED, RIGID POLYVINYL CHLORIDE** for the fabrication of fume exhaust systems, tanks, ducts, and similar products, is the subject of 6-page folder 9-1. Information is presented on fabrication, design factors, and physical strength. Resistance characteristics are charted to clearly indicate applicability to specific industrial corrosion problems, as well as its resistance to reagents at both low and high temperatures. *Atlas Mineral Products Co., 49 Ash St., Mertztown, Pa.*

**LUMINOUS, ACOUSTICAL CEILINGS**, combining attractive interior decoration with functional properties such as a high degree of acoustical correction and uniform light diffusion,

are the subject of an 8-page bulletin. They are described as being a translucent corrugated ceiling of vinyl plastic, suspended below continuous rows of fluorescent lamps. The literature shows how acoustical correction can be provided by installing perforated steel baffles. It also points out how the plastic can be installed below sprinkler heads. Other advantages, planning information, and costs are presented. *Luminous Ceilings, Inc., 2500 W. North Avenue, Chicago, Ill.*



**VERTICAL TRANSPORTATION**—Passenger and freight elevators, and electric stairways are described in 20-page booklet B 4586. In addition to discussing the various types available, the bulletin appraises the various elevator control systems. Layout drawings and tables present specifications and dimensions. *Elevator Div., Westinghouse Electric Corp., Jersey City, N. J.*

**VIBRATION MOUNTING SYSTEMS**, for maximum vibration isolation and shock protection of electronic equipment, is the subject of 16-page bulletin 750. The booklet defines vibration and shock, and shows the effect of vibration on equipment. It tells what can be done about this problem, and explains how knitted stainless steel wire can be applied as the resilient and damping element. Vibra-

tion control from theory to practice is discussed. *Robinson Aviation, Inc., Teterboro, N. J.*

**STANDARDIZED BUILDINGS**—“The Modular Method for Lower Industrial Construction Costs,” a 12-page brochure, has been published to acquaint engineers with standardized buildings. According to the bulletin, standard office modules and standard plant or warehouse modules can be assembled in any numerical combination or pattern to form the desired building. Buildings are based on 30 x 40 ft bays, with a clear height of 15 ft. The booklet explains how this type of construction lowers costs, and describes various interior and exterior treatments. *The Ferber Co., 16 Johnson Ave., Hackensack, N. J.*

**STRUCTURAL SPECIFICATIONS**—“Design Suggestions for Saving Structural Steel,” a 4-page folder, contains an article by V. R. P. Saxe. It presents a brief discussion of the possible benefits which can be secured by using former wartime specifications. Examples compare various types of riveted and welded design. *The Lincoln Electric Co., Cleveland 17, Ohio.*

**WELDING FITTINGS** for every piping service are listed in 36-page catalog W3. Dimensions and specifications are tabulated, and installation instructions are given. A technical section provides code and design data, design principles, reinforcement information, corrosion allowances, and suggestions for various types of construction. *Forged Fittings Div., Bonney Forge & Tool Works, Allentown, Pa.*

**ELECTRONIC AIR CLEANERS**, designed to completely clean ventilating air, are the subject of 4-page folder AS-106. The bulletin presents a case study of an installation for cleaning air in a power house control room located in a steel mill. *Trion, Inc., 1000 Island Ave., McKees Rocks, Pa.*

**CONTINUOUS, AUTOMATIC WEIGHING SCALES** for precise control of production input and output are the subject of 8-page bulletin 301. Advantages, operation, and application are discussed. Specifications are listed, and actual installations are described and illustrated. *Transportometer Div., Sintering Machinery Corp., Sinter Ave., Netcong, N. J.*

Personal copies of booklets can be obtained by writing directly to the manufacturers. Please mention this magazine. Thank you.

CORRUGATED ASBESTOS-CEMENT roofing and siding are the subject of 82-page manual 52. Numerous drawings and photographs show the exact method of application and erection. Recommendations for application, shipping and crating information, suggested specifications, and information for estimating quantities are presented. Additions and changes in specifications will be provided all holders of the manual to keep the book up-to-date. Philip Carey Mfg. Co., Dept. CM, Cincinnati 15, Ohio. Price 50¢.



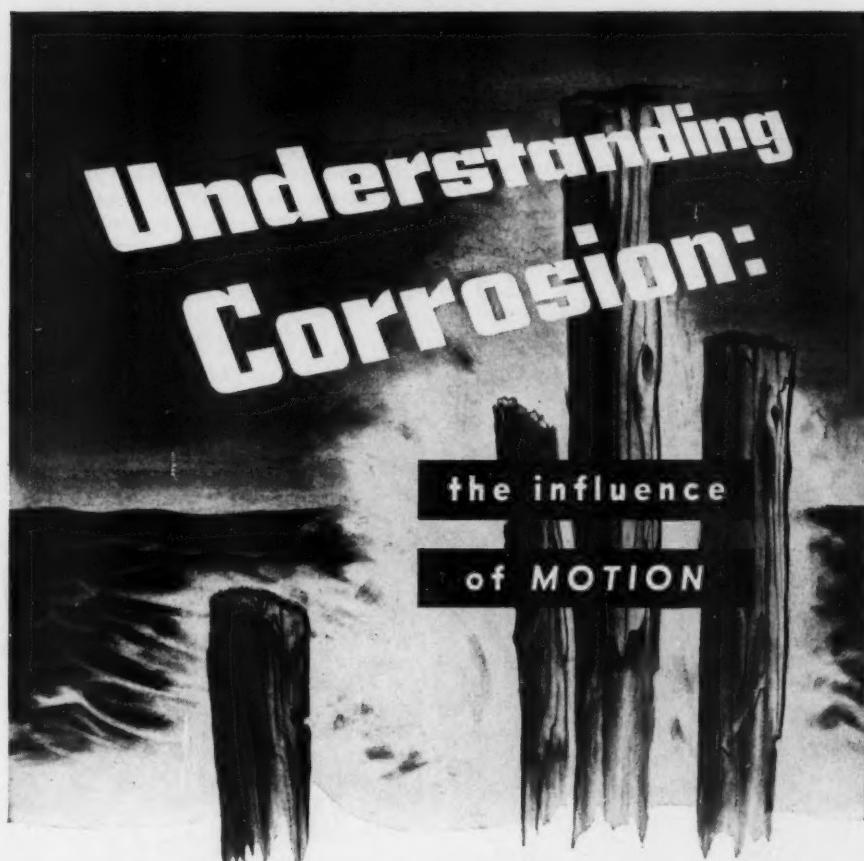
**CONVEYOR AND ELEVATOR BELTING—**This 36-page brochure has been published to serve as an engineering manual on belting installation and maintenance. An explanation on how to select belts includes considerable engineering data. Among the many topics covered are: how to make conveyor belts run straight; causes and effects of excessive tension; selection and installation of pulley lagging; ways to avoid belt wear at loading point; use of damage-preventing appliances; types of compensating idlers; and the effects of defective idlers. The B. F. Goodrich Co., Akron, Ohio.

MERCURY-VAPOR LAMPS are the subject of 28-page revised booklet A-5112. Application information and performance data are provided for both fluorescent-mercury and straight-mercury type lamps. Standard information on all sizes and types is listed in a table. Discussions include lamp and lumen maintenance, lamp temperature, ambient temperature, mercury lamp circuits, and performance when used with various transformers. In addition, subjects such as lamp construction and mercury radiation characteristics are discussed. Lamp Div., Westinghouse Electric Corp., MacArthur Ave., Bloomfield, N. J.

FLUORESCENT LIGHTING SYSTEMS for commercial and industrial applications are discussed in 8-page bulletin RL-253. The system consists of a minimum number of components, developed to provide a high degree of flexibility and economy. Dimen-

(Continued on page 76)

MAY 1953



Because increasing the degree of motion of a corroding solution brings more oxygen to the surface of the metal with which it is in contact, such increase has a decided influence on the rate of corrosion. In liquid that may appear quiet, convection currents are nonetheless at work slowly distributing dissolved oxygen throughout the solution. When velocity agitates the liquid-air interface, unsaturated liquid is brought to the surface layer and the oxygen-solution rate rapidly stepped up. At the same time the liquid film on the surface of the metal is thinned so that this increased amount of dissolved oxygen diffuses more readily. Thus the combined effect of more dissolved oxygen conveyed more rapidly to the metal is a marked acceleration of corrosion.

Velocity, too, is often the indirect if not the direct cause of mechanical erosion of metal, for the deterioration it helps bring about results in the formation of corrosion products. In a quiet system these might serve a protective function but with motion a factor they erode readily, leaving already weakened metal exposed to further corrosive attack.

The ever-varied interplay of its many governing factors render the mechanism of corrosion complex indeed. Recognizing effects, determining causes, and controlling those that can neither be eliminated nor regulated is a responsibility industry has long assigned to Dampney. The reduction of your corrosion problems through the medium of Dampney equipment-engineered protective coatings . . . formulations of vinyls, ceramics, asphaltums, silicones, chlorinated rubber and other natural and synthetic resins . . . is a responsibility we should likewise welcome.



153-1

HYDE PARK, BOSTON 36, MASSACHUSETTS

75

Sound Design

Quality Materials

Precision Workmanship

## the superiority of JERGUSON VALVES speaks for itself

### OS&Y Valves for severe conditions



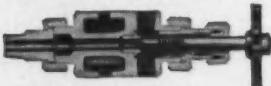
Rugged Jerguson OS&Y Valves are the ideal answer to meet high temperature or corrosive conditions where inside threads can't be tolerated. Efficient outside thread design eliminates possible freezing and allows the valve stem to work freely at all times.

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Tremendous time and cost savings are possible with Jerguson GA Valves. Threaded connections can be reduced from 10 to 3...unions, nipples, reducers, elbows, tees, valve, and bleed valve are combined in one space saving unit.

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Designed especially for use with heated or cooled gages, Jerguson No. 93 Valves have a surrounding jacket for circulating the heating or cooling medium. They give safe, dependable, leak-tight service.



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Jerguson Globe Valves, furnished in 1/4, 1/2, and 3/4 inch sizes with renewable, regrindable seats. Can be furnished with Stellited stem and/or OS&Y.

All valves shown rated at 3000 lbs. @ 500°F. Send for detailed Data Units...or outline your requirements and let Jerguson engineers go to work for you.

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Jerguson Tress Gage & Valve Co., Ltd., London, Eng.  
Pétrole Service, Paris, France

## BOOKLETS

—Starts on page 74

sions and specifications are included. Simplified calculation tables provide a short-cut, approximate method of determining the number of units required for any lighting installation. *Metalcraft Products Co., Inc. Masher & Lippincott Streets, Philadelphia 33, Pa.*

RUBBER LINED STEEL CONSTRUCTION for the transportation, storage, and handling of many acids and corrosive chemicals is the subject of an 8-page bulletin. Advantages of rubber lining for steel tanks, drums, pipes, valves, fittings, and pumps are appraised. Tables give resistance of rubber lining to inorganic acids, salts and alkalis, organic materials, and miscellaneous materials. Details on abrasive and temperature resistant qualities also are discussed, and the different types of available linings are described. *Protective Coatings Div., Metalweld, Inc., Scotts Lane & Abbottsford Ave., Philadelphia 29, Pa.*

PACKAGING EQUIPMENT, including gravity and power feed net weighers, overhead carriages, elevators, conveying equipment, and packaging controls, is described in 20-page brochure 101-W-E. Advantages, principles of operation, and specifications are given. *B. F. Gump Co., 1325 S. Cicero Ave., Chicago 50, Ill.*

DISTRIBUTION TRANSFORMERS are the subject of 4-page folder 50-FC. Units are air-cooled. Brief descriptions are presented for various types of units from 25 to 1000 kva with various primary and secondary voltages. Standard lighting transformers also are listed. *Marcus Transformer Co., Inc., 32-34 Montgomery St., Hillside 5, N. J.*

DISTRIBUTION PANEL BOARDS, plug-in type, are discussed in an 8-page bulletin. Units for both 250 and 575 v operation are listed. Design features, installation, engineering data, and application information are provided. Suggested specifications also are presented. *Federal Electric Products Co., 50 Paris Street, Newark 5, N. J.*

RECTIFIERS—The application of rectifiers to various operations is explained in a new brochure. An interesting question-and-answer section reveals the benefits of keeping d-c equipment working on a-c while retaining d-c speed control. Construction features and advantages are summarized. *American Rectifier Corp., 95 Lafayette St., New York 13, N. Y.*

REGULATING EQUIPMENT for steam, gas, air, oil, and water is described in 64-page catalog 53. Specifications and operational data are included for pressure, temperature, and combination pressure and temperature regulators, diaphragm valves, motor operated valves, float valves, pop valves, strainers, solenoid and motor valves, and water gages. Capacity tables are presented. Also included are flange charts, a table of steam pressures and corresponding temperatures, and a table of water heads and equivalent pressures. *O. C. Keckley Co., 400 W. Madison St., Chicago 6, Ill.*

CLOTH SCREEN COLLECTOR—The engineering features of a new dust collector, which uses the principle of reverse air flow for continuous cleaning of the cloth filters, are discussed in 6-page folder 915. The bulletin points out advantages said to reduce operating and maintenance costs. Design details, construction, and specifications are included. *Pangborn Corp., Hagerstown, Md.*



PYROMETERS for indication and control of temperature in industrial processes, and for protection of heat-processing equipment, are described in 12-page booklet GEC-713 B. Design features, applications, operation, construction, and specifications are presented. Information on thermocouple components and accessories, hand pyrometers, thermocouple potentiometers, resistance thermometers, and industrial resistance bulbs, also is presented. *General Electric Co., Schenectady 5.*

SELF-CLEANING STRAINERS, for removal of fine suspended particles from raw or process water, are described in a 12-page booklet. Operating principles, advantages, and construction features are described. Dimensions and operating capacities are tabulated. Various types of straining media also are presented. *S. P. Kinney Engineers, Inc., 201 Second Ave., Carnegie, Pa.*

STEAM ACCUMULATORS for balancing steam supply and demand are the subject of 8-page bulletin RA-52-8. Typical installations are discussed. Principles of operation and

advantages are described, and data are presented for calculating capacity. The practical application of accumulator theory is discussed. Foster-Wheeler Corp., 165 Broadway, New York 6, N. Y.

CENTRIFUGAL FANS, designed for high velocity, industrial air conditioning systems where low operating cost and quiet operation is required, are the subject of 8-page booklet 1320. A graph shows horsepower, efficiency, and pressure ratings. Information including maximum wheel speeds, total pressures, and volume ranges is presented for five classes of fans. Design features are discussed, and a system of movable vanes for controlling fan output is described. Sturtevant Div., Westinghouse Electric Corp., Dept. T-060, 200 Readville Street, Hyde Park, Boston 36, Mass.

DIESEL ELECTRIC SETS—To illustrate the variety of applications for diesel electric sets, 8-page bulletin 30658 presents actual case studies. Among the applications discussed are units used for power generation in the oil, logging, mining, construction, railroad, and radio industries. Use of the sets as emergency standby power in hospitals and public utilities also is discussed. A chart lists available sizes and their rated output for continuous and intermittent use. Caterpillar Tractor Co., Peoria, Ill.

HARD RUBBER PIPE AND FITTINGS are the subject of 4-page folder 96A. Physical and electrical properties of the material, described as being a heat and chemical resistant synthetic hard rubber compound, are discussed. A chart shows resistance to various chemicals. Available sizes of pipe and fittings are tabulated. American Hard Rubber Co., 93 Worth Street, New York 13, N. Y.

PACKAGE BOILERS for gas, oil, or combination oil and gas firing are appraised in 10-page bulletin A-104. A large cut-away view shows design and construction features of the Scotch-type boilers. Units from 20 to 100 hp are listed. Dimensions and specifications are tabulated. Eclipse Fuel Engineering Co., Rockford, Ill.

CAR SPOTTERS AND PULLERS, including both vertical capstan and horizontal drum designs, are described in 24-page booklet 2092. Features and specifications for many types are presented. Engineering information for calculating rope pull and for planning layouts is included. Although designed specifically for moving railroad cars, the literature

(Continued on page 78)

## World's Newest and Largest Helicopter Plant Selects ...



Bank of 12 Transformers  
Total Capacity 4000 KVA  
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RIGGS DISTLER & CO., INC.  
Philadelphia, Pa.

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They were selected because every detail of the Marcus dry type transformer is engineered for long life . . . and continuous, trouble-free performance. Latest contribution pioneered by Marcus for greater transformer durability is Hi-Heat, Hi-Dielectric Magnet Wire, insulated with DuPont's newest miracle polyester film "Mylar," combined with Johns-Manville "Quinterra" to reach insulation levels at least 10 times present industry standards.



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**CHROMALOX**  
ELECTRIC HEATING AT ITS BEST!

## BOOKLETS

—Starts on page 74

suggests many other industrial applications where horizontal haulage is required. *Link-Belt Co.*, 307 N. Michigan Ave., Chicago 1, Ill.

L. P. GAS STEAM VAPORIZERS for stand-by, peak shaving, or continuous service in both industrial plants and utilities are the subject of 4-page folder 8-52. Specifications, installation data, capacities, and a cut-away scale drawing are included. *Roth Manufacturing Co.*, P. O. Box 2358, Tulsa, Okla.

MILLIVOLT METER TYPE INSTRUMENTS, including indicators, indicating electronic controllers, and excess temperature safety cut-off controllers, are described in 24-page catalog 1053. Information on operation and applications of on-off, two-position, three-position, and pulse type time-proportioning controllers is included, together with data on primary measuring elements, dimensions, and scale selection tables. *Brown Instruments Div., Minneapolis-Honeywell Regulator Co.*, Station 64, Wayne & Windrim Aves., Philadelphia 44, Pa.

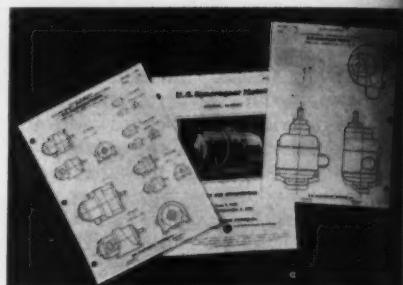
DIESEL DEVELOPMENTS—"New Developments in Oil Diesel, Dual-Fuel Diesel, and High Compression Spark Ignition Engines," 16-page booklet S-500-B55, describes up-to-date features of modern, economical, heavy-duty, internal combustion engines. A heat balance chart shows waste heat recoverable from exhaust gases and jacket cooling water. Also included is bulletin S-500-B54, which contains fuel cost charts for determining the most economical type of engine, and reprints describing industrial and municipal installations utilizing heat recovery systems. *Engine Div., Worthington Corp.*, Buffalo 5, N. Y.

WATER WELL ACIDIZING is discussed in a 12-page reprint. The article tells how to acidize water wells, and how it increases water yield. Engineering data are presented, and the results of water well acidizing in various parts of the country are discussed. *Dowell, Inc.*, Tulsa 3, Okla.

WIRE AND CABLE—"Wires and Cables for the Chemical and Petroleum Industries," a 76-page booklet, has been published to serve as a reference book on this subject. It is divided into four main sections: insulation compounds; jacket compounds; construction; and technical data. The compound sections have been expanded to include butyl insulation, heat and moisture-resistant

insulations, thermoplastic types, general-purpose neoprene jacket, and the polyvinyl chloride type jacket. *Electric Wire and Cable Dept., United States Rubber Co.*, 1230 Avenue of the Americas, New York 20, N. Y.

CONSULTING SERVICES, 14th Edition, 144 pages, is published to acquaint readers with the services of consulting chemists and chemical engineers. About 200 activities are classified, together with references to consultants providing each service. Qualifications, activities, and unique equipment of each organization are described. An index lists firms both alphabetically and geographically. *Association of Consulting Chemists and Chemical Engineers, Inc.*, 50 East 41st St., New York 17.



GEARMOTORS—Scale drawings of gearmotors from 1/3 to 30 hp, with speeds of 5 to 10,000 rpm are offered to layout draftsmen, designers, engineers, and architects. Drawn in a simplified style, but to exact scale, they are designed to be inserted under a layout for tracing. Three views of each motor are included in scales from  $\frac{3}{8}$  in.=1 ft to 3 in.=1 ft. To aid in selecting the proper motor, a booklet giving specifications and dimensions is included. *U. S. Electrical Motors, Inc.*, Terminal Annex, Box 2058, Los Angeles 54, Calif.

BOILER FEEDWATER DEMINERALIZATION—Mixed bed and two-step demineralization to meet specifications of high pressure boiler feedwater is discussed in 16-page reprint 383. The economic aspects of demineralizing various water supplies are discussed. Cost comparisons are outlined, make-up water requirements are specified, and curves show economies of operation. *The Permutit Co.*, 330 West 42nd St., New York 33.

SOLVING ROOF PROBLEMS, 36-page brochure U614b, contains useful information on the various types of roofs commonly used. In addition to outlining the various types and their advantages, the booklet discusses how roofs are built, how troubles are diagnosed and treated, and when to discard built-up roofs. *The Tremco Manufacturing Co.*, 8701 Kinsman Rd., Cleveland, Ohio.

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# consulting engineers' calendar

Date	Sponsor	Event	Location
May 18-19	Association of Iron and Steel Engineers	Spring Conference	Statler Hotel Buffalo, N. Y.
May 18-20	American Management Association	Insurance Conference	Hotel Statler New York, N. Y.
May 18-22	Materials Handling Exposition	5th National Show	Convention Hall Philadelphia, Pa.
May 19-21	National Association of Corrosion Engineers	Corrosion Control Institute	University of Wis. Madison, Wisconsin
May 20-21	Armed Forces Chemical Association	Annual Meeting	Waldorf-Astoria New York, N. Y.
May 20-22	Engineering Institute of Canada	Annual Meeting	Nova Scotian Hotel Halifax, N.S., Can.
May 20-22	Society for Experimental Stress Analysis	Meeting	Hotel Schroeder Milwaukee, Wis.
May 21	Society of Fire Protection Engineers	Meeting	Palmer House Chicago, Ill.
May 24-28	American Society of Mechanical Engineers	Oil and Gas Power Division	Hotel Schroeder Milwaukee, Wis.
May 26-27	American Institute of Electrical Engineers	Electric Heating Conference	Detroit, Mich.
June 1-4	Edison Electric Institute	21st Annual Convention	Atlantic City, N. J.
June 7-12	Society of Automotive Engineers	Summer Meeting	Hotel Ambassador Atlantic City, N. J.
June 15-19	American Society of Civil Engineers	Spring Meeting	Casablanca Hotel Miami Beach, Fla.
June 15-19	Basic Materials Conference	Conference & Exposition	Grand Central Palace New York, N. Y.
June 16-19	American Welding Society	Exposition	Shamrock Hotel Houston, Texas
June 17-19	American Management Association	General Management Conference	Hotel Statler New York, N. Y.
June 18-22	National Society of Professional Engineers	Meeting	Sheraton Beach Hotel Daytona Beach, Fla.
June 20-25	American Institute of Chemical Engineers	Nuclear Energy Meeting	University of Mich. Ann Arbor, Michigan
June 22-26	American Society for Engineering Education	Annual Meeting	University of Fla. Gainesville, Fla.
June 23-25	Massachusetts Institute of Technology	Modern Highways Conference	M. I. T. Cambridge, Mass.
June 28-July 2	American Society of Mechanical Engineers	Semi-annual Meeting	Hotel Statler Los Angeles, Calif.

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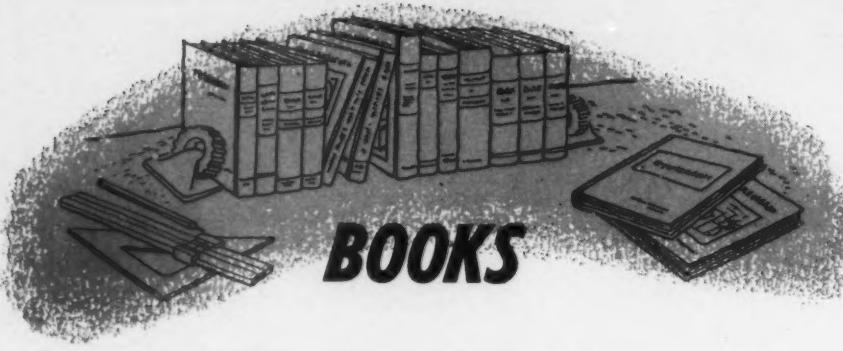
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### TO ORDER BOOKS

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**FOUNDATION ENGINEERING**, by Ralph B. Peck, Walter E. Hanson, Thomas H. Thornburn, John Wiley & Sons, 410 pages, \$6.75.

Reviewed by  
Edward R. Estes, Jr.  
School of Engineering  
University of Virginia

The science of soil mechanics is an integral part of the design of foundations. Quite often the two are considered separately with no effort made to correlate the theory of one with the practice of the other. The authors of this text have tied together the components necessary for a satisfactory foundation design in presenting a broad picture of foundation engineering.

The four parts of the book—Properties of Subsurface Materials, Types of Foundations and Methods of Construction, Selection of Foundation Type and Basis for Design, Structural Design of Foundation Elements—serve to carry out the purpose of the book in giving the necessary knowledge to analyze the sub-surface condition, choose a suitable foundation and design its component parts.

After describing the methods of soil exploration, identification, and classification, the authors apply this information to the selection of foundation types. By showing the behavior of different foundations in different soils, they pass on to the reader a background to be used as a basis for design. The section on reinforced concrete design follows the 1951 ACI Building Code and utilizes the results of Professor F. E. Richart's investigation of footing behavior.

*Foundation Engineering* is better as a general text for study of soil

mechanics and foundations than as a reference for the individual subjects. However, illustrative problems throughout and a section devoted to typical problems encountered in practice make it more useful for the engineering library.

**THE NEW SCREW THREAD MANUAL**, American Society of Mechanical Engineers, 68 pages, \$2.50.

Reviewed by  
George T. Trundle, Jr.  
Chairman, Board of Directors  
The Trundle Engineering Co.

This most important and necessary handbook, recently published by the American Society of Mechanical Engineers, is the culmination of 50 years of argument, conference, and compromise. It is a shop and drafting room abridgement of the American and Unified Standards for screw threads and their gages. The volume contains the American standards and those that were set by the Accord of 1948, signed by Canada, Great Britain, and the United States. The agreement was designed to assure the interchangeability of screws and threaded products of those nations.

Serious discussions of standardization were underway for several years when, in 1902, the American Society of Mechanical Engineers appointed a committee to prepare a report on "Standard Proportions for Screw Machines." The five year task of that committee was crowned with success when the report was adopted at the society's convention of May, 1907, at Indianapolis.

World War I gave tremendous impetus to the move for international cooperation. The difficulties the Al-

lies experienced in repairing each other's equipment started the agitation for international unification of thread standards.

American standardization, however, was progressing rapidly. In October, 1916, the Navy Department accepted the standards for machine screws of ASME. The five and one-half year task of the society's Committee on Tolerances in Screw Thread Fits was adopted and published in February, 1918.

International progress was far slower. Despite the serious lessons learned during World War I, no progress was made between the one-time Allies. The United States and Great Britain were still separated by the five degree difference in the screw thread angle with the U. S. clinging to the 60 degree angle.

The first break in the international stalemate came in 1926 when a British mission visited the United States and brought with it the compromise proposal of a 57½ degree thread angle. This squarely split the five degree difference. But American refusal to alter its now established angle brought the work of the mission to a fruitless end.

With the coming of World War II, the United States poured billions of dollars worth of material into the hands of the British, French, and other Allies. Once again the cry for unity was heard. By December, 1943, two years after the United States was at war, the first of the new series of international conferences took place in New York. A second round of conferences followed in London during August and September of the next year. A third meeting was held at Ottawa, Canada, in October, 1945. At that Canadian conference, the British agreed to adopt the American screw thread angle of 60 degrees and proposed what later became known as the Ottawa thread form.

However, American objections remained to crest and root contours. But the basic differences had been resolved and each nation then was permitted to follow its own preferences since the products would be interchangeable. The work thereafter was carried on by small conferences between the three nations on the computation of tolerances, and allowances for all diameters, major and minor, and pitch of external and internal threads. That work lasted into the fall of 1948. In November of that year, the most important industrial pact ever written was signed. It was the Declaration of Accord, and to it was affixed the signatures of governmental and industrial representatives of the three nations.

And all that effort, the years of frustration, the discord of nations, and then the final agreement is summed up in the tables on the pages of a book which, in its appearance, fails

to reveal all the turmoil that had gone before.

It is hoped that this monumental work clothed in its modest binding will find its place at every drawing board and in every shop throughout the country.

**INDUSTRIAL PROCESS CONTROL BY STATISTICAL METHODS**, by John D. Heide, McGraw-Hill Book Company, Inc., 297 pages, \$6.00.

Reviewed by  
Mary Jo Wesson  
Research Division  
West Point Manufacturing Company

In the preface, Mr. Heide states that his book is designed for the man who wants to use statistical methods in the control of processes but who does not have the services of a statistician, either academic or industrial. Mr. Heide has successfully attained his goal. He has gone even farther in that he has provided the academic statistician with an excellent source of industrial problems and solution.

The author begins his book with the evolution of process control philosophies and carries it, step by step, to its logical conclusion of evaluation. The statistical methods and concepts introduced in the text are explained in easily understood language and are accompanied by excellent illustrations taken from industry.

In any industry the control of the processes involves several groups of people. Operational personnel are directly concerned with the process, laboratory and quality control personnel are concerned with the measurement of the product of processes, and management is concerned with the over-all picture of the plant operation. Each group must use a different approach to the problem. The author has very ably presented material for each of these groups.

The chapters on presentation of data, control charts, limit lines, specifications, and the study of data are clearly written and so presented that operating supervision should have no difficulty with this "new" concept of process control. For the man or men concerned with the organization and installation of process control by statistical methods, the author has presented an excellent description of what is expected from a quality control department, how to organize the department, and practical aids in carrying out the program as well as instruction in statistical methods. For management there are quality reports and evaluation or rating of quality.

Special emphasis should be placed on the fact that an entire chapter has been devoted to the evaluation of test procedures and test results. Not too many authors have realized the importance of test methods and com-

prehended the concepts of testing error. Too many mention test methods and test errors just in passing. The various appendixes are very well chosen and serve to make the book complete.

**CELLULOSE: THE CHEMICAL THAT GROWS**, by William Haynes, Doubleday & Company, 383 pages, \$4.00.

Reviewed by  
Don Lacoss  
Superintendent of Cellulose Acetate  
Celanese Corporation of America

This book is a history of cellulose used as a chemical. It is a story of the early development work on cellulose products, as well as a story of chemical cellulose industries of today. It tells the history of the development of nitrocellulose and its lacquers; of man made fibers from cellulose such as viscose, cellulose acetate, and cuprammonium yarn; of chemical cotton, high alpha wood pulp, and other chemical cellulose industries.

Mr. Haynes makes lavish use of anecdotes and stories of the personalities involved. Some such as Charles F. Kettering having a car painted with a fast drying nitrocellulose lacquer while he and the innocent owner ate lunch are familiar, but they are all interesting.

This is not a technical book. However, in reading it, one finds an easy and pleasant way to acquire considerable knowledge of cellulose and its use as a chemical. People working in chemical cellulose industries, in particular, should enjoy the book.

## INDUSTRIAL FILMS

"**PLEASE PASS THE CONDENSATE**," sound and color, 20 minutes, Yarnall-Waring Company, Philadelphia 18, Pa. Portrays the operation, selection, application, and maintenance of steam traps—all with the ultimate aim of getting more production from steam heated equipment through reduced heat-up time and hotter operating temperature, as well as shortened down-time for repairs and cleaning. It is now available for showing to engineering groups.

"**THIS AMAZING HEAT**," sound and color, 16-mm, 24 minutes, Edwin L. Wiegand Company, 7500 Thomas Blvd., Pittsburgh 8, Pa. Typical electric heating applications are graphically illustrated. Shows resistance-type electric heating units at work in a wide range of industrial processes. A number of case histories are used to show important benefits of using the basic strip, tubular, radiant, and cartridge units, individually or in packaged combinations. Applications cover many different industries.

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